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THE GLORIOUS ROAD

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Chief Engineer of the Kuznetsk Metallurgical Combine

In 1930 the Communist Party put before the Soviet people a grandiose task – to create in the East a second coal mining and metallurgical centre for the country: Ural-Kuzbass. The construction in Siberia of the large scale Kuznetsk Metallurgical Combine, equipped with modern techniques, constituted one of the main links of Ural-Kuzbass.

The construction of the Combine was set at a full pace in the spring of 1930. On the 1st of May the foundations of the first blast furnace were laid and in 23 months the first pig iron was obtained. In October 1932 the first Martin (open-hearth) furnace was started, in November the blooming mill and in December the rail mill began operation. In this way, already in 1932, nine months after starting-up the blast furnace, the essential construction of open-hearth furnace plant and rolling plant was completed. The Kuznetsk Metallurgical Combine joined the family of existing active concerns with a full metallurgical cycle.

In 1931 the construction of Telbessk and Temirsk mines in Gorna Shoriya was initiated and in 1932 the first consignment of iron ore left these mines.

The starting-up of a large metallurgical combine in Siberia played an outstanding part in the industrialization of the whole country and especially of the rich but industrially backward eastern regions.

The construction of the Combine is an outstanding example of the heroism of the millions of workers, collective farmers and Soviet intelligentzia who, under the guidance of the Communist Party, carried out the great plans for the industrialization of the country in unprecedented short time.

In twenty-five years the Kuznetsk Combine has grown into an important complex concern including in its undertakings several mines, two agglomeration plants, a number of main and subsidiary plants and branch establishments.

The Combine produces coke, by-products coke chemicals, blast furnace metal (pig iron), steel, structural and laminated rolled steel, rails, fire resisting articles and other products.

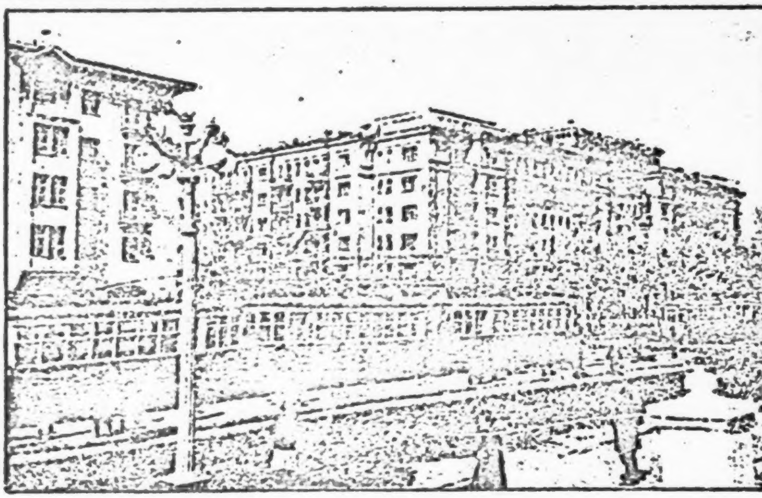
In a quarter of a century of production the metallurgists of Kuznetsk have given the country many millions of tons of pig iron, steel and rolled materials.

An enormous part was played by the Kuznetsk Metallurgical Combine during the years of Great Patriotic War when it supplied the Soviet armed forces with a first class material. For having succesfully attained the objects of the State Defense Committee the Combine was rewarded with the Order of Lenin, Orders of Kutuzov – First Grade, and Order of the Red Banner of Labor. The Kuznetsk citizens were given four Challenge Banners of the State Committee for safekeeping in perpetuity.

The continuous growth of production was achieved mainly on account of the improvement of efficiency in the basic metallurgical units. Especially remarkable successes were achieved by the Kuznetsk citizens in the post-war years.

In order to increase still further the production of pig iron, steel and rolled steel products, the metallurgists of Kuznetsk have done a great deal on the reconstruction and modernization of the units and equipment and on the introduction of modern techniques and technology.

Automation has been introduced in many production processes. The furnaces of the blast furnace plant have been modernized with an increased useful capacity; the construction and the automation of the air heaters have been improved, the charging of the blast furnaces has been made automatic. The application of the blast of a constant and increased humidity and of an increased gas pressure made possible an intensification of the blast furnace process. The blast furnace workers of Kuznetsk have been the first in the USSR to develop and introduce these measures. In the last two-three years the preparation of the raw materials has been considerably improved, the production of the fluxed agglomerate has been mastered and so has the smelting of low manganese content raw iron; all this was also conducive to the improvement of the technological and industrial efficiency of the blast furnace work.



Stalinsk, Molotov Avenue (TASS Pictorial Review).

Assisting the blast furnace workers, the coke plant operators achieved the finest milling of coal in the Soviet Union which resulted in the improvement of the coke quality, and the coal, which until then was considered coking, has begun to be utilized in the coke oven charge.

In the open-hearth furnace plant the design of the furnaces is improved, the hearth area is increased and full automation of the heating system is completed. All furnaces are equipped with magnesite-chromite roofs and with air injection jets. These measures have made it possible to increase heat intensity and to speed up the furnace work, shortening the time taken for the steelmaking process. Owing to the improvement in the organization of labor, a substantial reduction in the time of charging of open-hearth furnaces has been achieved, the steel casting has been improved, the durability of the checker brickwork of the regenerators has been increased, and the lost time on hot and cold maintenance markedly shortened. The technology of the manufacture of steel of various brands has been perfected, as well as the reduction of low manganese content blast furnace metal without adding ferromanganese in the course of the steelmaking process.

In the electric steelmaking plant the durability of the furnace lining has been improved and the manufacture of high quality alloy steel has been mastered. The electroheating of the shrinkage head of ingots has been developed and the experiments on the equipment for the evacuation of steel are being carried out. The measures taken have made it possible to increase substantially the output of electrosteel and to improve its quality.

The personnel of the Kuznetsk blooming mill has achieved considerable success. The reconstruction of the mill and the automation of heating-up and rolling of ingots together with the enlargement and the construction of additional soaking pits made it possible to achieve an unprecedented level of production.

The output of rolled steel in the rolling mills also increased. The adoption of such measures as the installation of the universal stand of mill 750, the retarded cooling of rails, the automation of the rolling process in the medium-grade plant, the modernization of the finishing stand of the medium-sheet rolling mill,

the improvement in the means of finishing and cleansing of sheets in the sheet rolling plant made possible not only an increased production but created conditions for the introduction of several new profiles of rolled steel including tramway rails, plowshares, rail clampings for the reinforced concrete sleepers, etc.

The rolling mill operators of Kuznetsk are pioneers in metal rolling with negative tolerances.

A great deal has been done by the personnel of the railroad section and the mechanical and power plants to ensure normal functioning of the main metallurgical production. As a result of the improvement of work organization in the railroad section the number of loaders decreased by nearly threefold with a continuous increase in output. During that time there were introduced the scrapers for the unloading of flat cars, scraper loaders, chute drawer elevators as well as self-unloading cars of various types.

During the past period a great deal has been done on the strengthening and development of the ore mining base of the Combine. The first agglomerate from the Mundybash agglomerate factory was delivered to the blast furnaces in 1935. In 1941 Tashtagolsk and Odra-Bashsk mines were put into operation; in 1950 Shalymsk mine, and in 1952 Sheregesh mine were started. The introduction of these mines made it possible to increase the amount of local ore in the blast furnace charge from 32.6% in 1940 to 82.5% in 1954. However, in spite of continuous increase in output of local ore, its percentage in the blast furnace charge has not increased but has even fallen to 78%. The explanation is to be found in the increased consumption of raw materials by the blast furnace plant in connection with further intensification of the blast furnace process and the increase in the volume of the blast furnaces.

In December 1956 the first section of the Abagursk agglomerate plant was put into operation.

The introduction of effective mining methods in the mining division of the Combine, such as block crumbling, breaking of ore by deep bore mines and the introduction of drilling machine BA-100 which was developed by Kuznetsk miners together with the Siberia Branch of the Academy of Science of the USSR and which made it possible to perform drilling work in hard ores several times faster than with earlier equipment; all this contributed to the increase in the output of iron ore and of the agglomerate.

The creative work of inventors and innovators was of great importance in the successful and fruitful efforts of the many thousand workers of the Kuznetsk Combine. In the course of 25 years over 28,000 suggestions have been adopted in the Combine, saving yearly 217 million rubles. In the post-war years alone about 1000 new devices in the mechanization of heavy and labor-consuming work have been introduced, thus reducing manpower required and making it possible to employ over 2000 workers on other tasks and to improve conditions of work for 5200 workers.

The personnel of the Combine constitute the basis of the Combine's success. An exceptional political and technical development of the personnel has to be acknowledged as one of the most important outcomes of the Combine's 25 years of operation. To a great extent this advance is due to the broad technical education: further-education courses, courses for foremen, schools for working young people, evening and external departments of the Technical School of Metallurgy and the Metallurgy Institute comprise about 9000 workers of the Combine. The majority of workers came to Kuznetskstroy in the early part of 1930-1940 years, were employed on the site as carpenters and diggers and after the construction was completed they took jobs at the plant.

The development of socialist competition has played an important part in the successes we have achieved. Plants of the Combine won several times All-Union socialist competitions. The traditional competition between Magnitogorsk and Kuznetsk Combines is of special importance.

As the Combine grew so did the city of metallurgists – Stalinsk. In the prewar Five-Year Plans, Stalinsk begame a well built modern town. This big industrial center in Siberia has continued to grow in the post-war years. In the course of the fifth Five-Year Plan over 400,000 sq. m. of living space have been put into service. In 1956 the housing resources of the town increased again by 125,000 sq. m. Three hospitals, five polyclinics and dispensaries, two sanatoria, many kindergartens, schools and a great number of cultural and social institutions have been opened. The town has a drama theatre, cinemas, clubs and several hotels. There are 70 schools for general education in Stalinsk. Thousands of students study at the Siberia Institute of Mining and Metallurgy, in the State Pedagogical Institute and other higher and secondary educational establishments.

When celebrating the 25th jubilee of Kuznetsk Metallurgical Combine and recording the successes and feats of our personnel we should also mention the shortcomings of our work. The shortcomings show, first of all, in lagging of the development of our mining section. The increase in the output of pig iron made the problem of ore supplies for the Combine a very acute one. For further growth in the production of pig iron it is indispensable to increase the ore output and to improve ore dressing. With this aim in view the Abagan mine should be put into operation and the construction of Teisk mine should be started during this current year. In one or two years the modernization of the existing mines should be completed and the Abagursk agglomerate factory should be enlarged. The accomplishment of those tasks and the construction of two coke oven batteries will allow us to provide all the required supplies of iron ore and of agglomerate from local sources even after the construction of an additional powerful blast furnace.

The necessity has arisen for expanding the maintenance and machineshop section of our Combine. At present, in connection with the introduction of new plants and mining undertakings, the maintenance and machine-shops are not in a position to provide all the services required. Further increase in steel production is delayed not only by the shortage of blast furnace metal but also by inadequate blooming outfit. Although the blooming mill achieved the highest output in the Soviet Union it already cannot cope with the processing of all the ingots.

The lagging behind of the mining section and the disproportionate capacities of separate plants of the Combine have not developed suddenly or recently. The management and the Party organization of the Combine has drawn attention more than once to those problems. In order to ensure further increase in metal output it is necessary to solve urgently all problems bound up with the elimination of the bottlenecks. In this the Combine needs support and assistance.

By making use of advanced experience, by learning and introducing modern methods and technology, the personnel of thrice honored Kuznetsk Combine will persevere in the search for new reserves for pre-schedule fulfilment of the 1957 plan.

DEVELOPMENT PROSPECTS OF THE KUZNETSK METALLURGICAL COMBINE

G. V. Sharov

Director of Technical Division

A significant feature in the development of the Kuznetsk Metallurgical Combine over the past years is the continuous increase in metal output as a result of making better use of production capacities.

The blast furnace of the plant was constructed in 1934, the last open-hearth furnace was put into operation in 1940, the latest rolling mill started production in 1950. From that time, without introduction of new units, the output of pig iron, steel and rolled iron has increased substantially. The design capacities, set out in 1936, have been exceeded long ago. The creative minds of Kuznetsk blast-furnace operators, rolling mill operators, smelters and engineers search continually for new sources of output increase.

The increase in metal output has been attained owing to technological development, application of new technique and modern work methods in all branches of metallurgical production and owing to the perseverance and efforts of Kuznetsk metallurgists who started, in a big way, the socialist competition for the pre-schedule fulfilment of production plans.

In the blast furnace production, for instance, the change-over to the blast of constant humidity at an increased gas pressure in the stack made it possible to increase furnace output by 10% and to lower specific consumption of coke by 3% with the simultaneous lowering in the loss of the furnace dust. The utilization of production of fluxed agglomerate and its application in smelting process made it possible to increase pig iron output by 2-3% and to lower coke consumption by 10% per ton of pig iron.

The production of agglomerate in 1956 has been increased 2.1 times compared with 1950, all agglomerate being fluxed. The modification of the smelting technology of cast iron for steel manufacture by taking out of the charge the manganese, containing additions which introduced a considerable amount of phosphorus, resulted in the increase of blast furnace output by 4% and alleviated the troubles with phosphorus in open-hearth furnaces. The modernization of the air heaters and installation of more powerful gas burners made it possible to raise the temperature of blast and to lower specific consumption of coke.

The enlarging of furnace volume and the improvements in technology allowed the Kuznetsk blast furnace operators to raise the utilization of the blast furnace volume in 1956 by 26% as compared with 1950 and to get some additional thousands of tons of pig iron, this being equivalent to the putting into operation of a new powerful blast furnace.

In the open-hearth furnace plant the furnaces have been modernized by introducing new refractory and increasing the charge. The introduction of magnesite-chromite roofs of improved construction increased considerably the durability of the furnaces. In 1956 the mean durability of roofs of 185 ton open-hearth furnaces reached 654 runs, and of 380 ton open-hearth furnaces 475 runs. In 1955 a full change-over to high refractories in all the open-hearth furnaces was completed and in consequence idle time was cut down and furnace operation was intensified. In 1956 idle time had fallen down to 6.2% and the output of steel per sq. m. of furnace floor increased 1.6 times compared with 1940 and amounted to 8.95 tons.

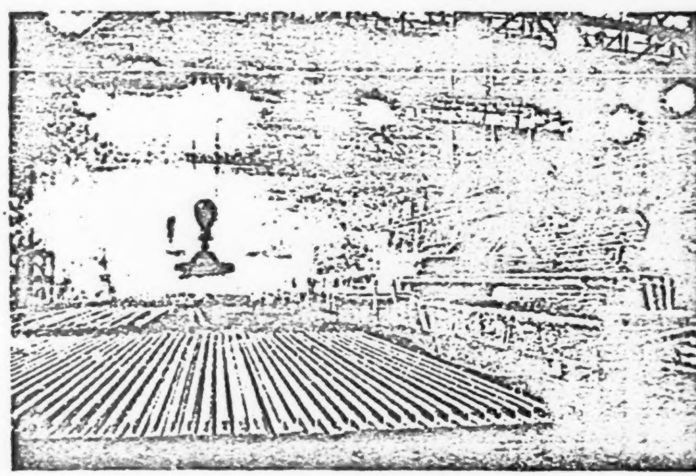
The improvements in the steelmaking process and introduction of new installations made it possible for the Kuznetsk metallurgists to increase steel output by 1 million tons which represents the productive capacity of approximately six new 185-ton open-hearth furnaces.

In the rolling plant production, attention was chiefly paid to the improvement of the blooming mill. A complex modernization of mechanical and electrical installation of this powerful plant and the automation of the rolling process of ingots together with other innovations, made it possible to increase production considerably. Although the blooming production in 1956 increased substantially in comparison with 1940, the blooming remains still a bottleneck of the Combine, slowing down the production and not meeting satisfactorily the requirements of rolling mills in pressed material.

The outstanding increase in metal production, by far exceeding the original design capacity, caused acute disproportions between the basic branches of production, upset the normal power requirements balance, created several bottlenecks and resulted in exhaustion of many spare capacities which are so very essential for normal functioning of a large metallurgical concern. Further growth in metal production in 1956 yet more sharply emphasized several disproportions and bottlenecks. The disparity became greater between the pig iron production and iron ore supplies, between steel production and inadequate capacity of the blooming mill, between the capacities of blooming mill and rolling plants. Even greater disparity became apparent between the output of coke oven gas and the requirements of fuel consumers.

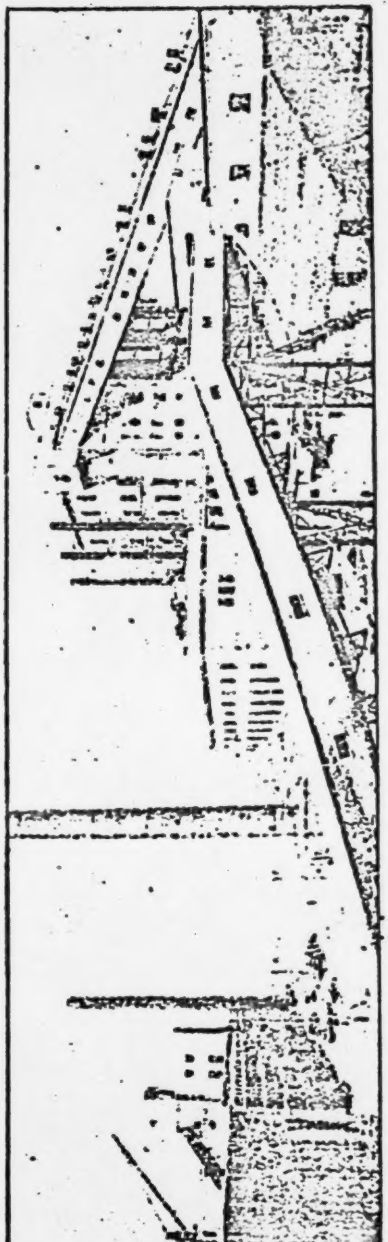
The disparity between the coke output and the coke requirements of the blast furnaces is increasing. The maintenance and mechanical shops became inadequate for the normal requirements of the Combine's plants.

Fast development of the local ore mining center constitutes the essential and decisive condition for the successful work of Kuznetsk metallurgists. There can be no talk now about the shortage of iron ore in West Siberia. The discovery of new deposits and the prospecting of previously known iron ore fields have brought about a complete change as regards the iron ore reserves in Western Siberia. The discovered ore deposits will fully satisfy, for many years to come, the needs not only of Kuznetsk Combine and the new West Siberia metallurgical plant but also of other metallurgical industries to be developed in Siberia. At present it is imperative to expand the construction of new mines and the modernization of existing ones.



Unloading of ready rails. (Photo L. Vilner).

In 1957 the Combine will put into operation the Abakansk mine in Khakassiya, the new iron ore center of the Combine. The utilized iron ore centre in Gornaya Shoriya will be supplemented by a more powerful center in Khakassiya, whose mineral wealth it is hardly possible to overestimate. The required ore supplies for the Kuznetsk Combine can be secured, for many decades to come, with the iron ore of the Khakassiya deposits only. Following the completion of the Abakansk mine in 1957, the construction of Teisk mine will unfold. If the construction of new mines and the modernization of existing ones receives the required impetus, there will be a practical possibility in 1961 not only of providing all supplies for the Kuznetsk Combine but also of providing for essential reserves. To achieve this, a decisive change in the development of iron ore centers in Siberia is necessary.



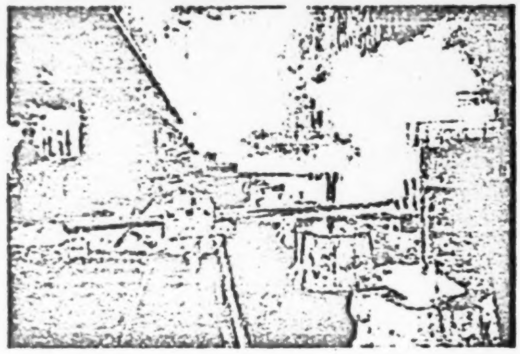
Abagursk concentration and agglomeration plant. (TASS Pictorial Review).

Kuznetsk furnace operators made good use of the volume increase of existing furnaces to increase pit iron output. The effective volume of the blast furnaces in 1957 increased by 1.8. Further enlarging of furnace volume requires large scale construction which would be difficult to carry out. The raw iron ore preparation providing a high iron content in ores and agglometate remains an essential condition for high productivity of blast furnaces. Of great importance for the achievement of this end will be a further development of Abagursk Concentration and Agglomeration plant which started operation at the end of 1956. It will have the number of agglomeration belts increased to seven. The expansion of the plant would make it possible to arrange for the production of open-hearth furnace agglomerate and to eliminate the deficiency in open-hearth iron ore. A better utilization of blast furnaces will be achieved also by a further rising in the temperature of hot blast and by increasing the moisture content of the blast. The construction of a new large blast furnace has been planned.

The deterioration of the balance of metallurgical coke and the acute shortage of coke oven gas for the open hearth-furnaces and for the heating furnaces of the Combine raise acutely the problem of speeding-up of the construction of new coking plants. It should be also borne in mind that the condition of the first four coking batteries, working without an overhaul since 1932-1934, deteriorates continuously. In 1957 the Combine will start the construction of two coke oven batteries of 77 ovens each, the chamber volume being 30 cu. m.

The development possibilities of the Kuznetsk Combine depend, essentially, on the possibilities of further increase in the output of open-hearth steel. The open-hearth furnace plants can increase production by the intensification of the steelmaking process but only under the indispensable condition of eliminating the bottlenecks in the open-hearth plants themselves as well as in the adjoining sections. Only by the application of oxygen for the intensification of steelmaking process can a steel output increase, equivalent to the operation of four new 185-ton open-hearth furnaces, be achieved. In order to utilize these capabilities it is necessary to expand the sections dealing with preparation of iron scrap, to enlarge charging yards and means of conveyance and of charging of furnaces, to increase the capacity of the casting bays, and enlarge the section of stock preparation.

The increase of the charge of open-hearth furnaces constitutes undoubtedly the right approach to the expansion of steel-output. While in 1950, 185-ton open-hearth furnaces constituted 60% of all the furnaces of the Combine, in 1956 they amounted only to one third of



Electric-arc heating of the shrinkage head of ingots in the electric steelmaking plant.
(Photo L. Vilner)

the total number. Kuznetsk steelworkers have mastered the production of alloy steel in large open-hearth furnaces. Further increase in weight of furnace charge is restricted by the load-lifting capacity of casting cranes.

We consider as a very important factor the adoption of "floating" metallic feeder heads for casting instead of ceramic ones. Ceramic feeder heads have several very valuable properties (small volume of the hot top, the ease of weight control of ingots), but they increase the steel cost considerably. In our Combine, an original construction of a "floating" metallic feeder head which retains all the virtues of the ceramic one, has been developed. With the completion of the preparatory work in 1957 the Combine will change over entirely to the "floating" metallic feeder heads.

In the rolled stock production special attaintion has to be paid, as in the past, to the blooming plant. Although the Kuznetsk blooming plant has achieved the highest productivity in the country, its productivity is nevertheless below the productivity of the steelmaking plants. The Combine has to send out to other metallurgical plants thousands of tons of ingots. The excessively high production strain on the blooming plant resulted in a dangerous overloading of important installations, particularly of the main electric motor.

As a result of overloading of the blooming plant, a situation has arisen in which further increase in metal output is hampered. In particular, there are difficulties in the production of light sections, as the rolling of the requisite billet for the rolling mills would lower substantially the productive capacity of the blooming plant. In 1957 the replacement of the main electric motor by a more powerful one is planned. The calculations show, however, that the rolling mill will not be in a position to utilize to the full extent the additional power of the new motor as the mechanical strength of the installations of the plant is inadequately reliable.

The inevitable need for equipment in the finishing plant of the second blooming mill has been felt for a long time. The Ministry of Ferrous Metallurgy, however, has done nothing in the course of past years to add to the finishing equipment in the Kuznetsk Combine, in spite of insistent appeals by the Combine. Now, even an immediate decision on the equipment of the second blooming mill will result in the loss of production over approximately the next three years while the new blooming mill is under construction.

The equipment of the second blooming mill will make it possible not only to increase steel output, but it will also provide favorable conditions for the production of additional hundreds of tons of rolled iron products. The additional rolled stock will be obtained by full utilization of highly efficient plants, which are now utilized to not more than 78% of their capacity. The strengthening of cutting facilities of the Combine will result in a reliable capacity reserve and will lay a firm foundation for the production of new type sections, especially light rolled girders and channel bars. The required higher quality standards of railroad rails have necessitated several modifications in rail and girder plants, in particular in the rail finishing workshop. As a result of modernization, the plant will be able to produce railroad rails 25 m long, hardened by means of high frequency current. The introduction of contact electrowelding of short rails is under consideration.

In connection with the expansion of the production of high quality sheet steel, a sheet finishing plant will be constructed in which sheet steel will be subjected to etching, heat treatment and cold rolling.

There is a lot to be done regarding the expansion of the power plants, the expansion of the maintenance and workshop divisions, and the development of the plant railroad system with a view to converting it to internal combustion traction. Special attention will be paid to further mechanization of labor-consuming and heavy operations and to the automation of production processes.

The community of the Kuznetsk metallurgists can note with satisfaction that their efforts have brought good results. By increasing continuously the rate of metal production, the Kuznetsk Metallurgical Combine constitutes a powerful base in the socialist transformation of Siberia, a base of the socialist industrial development of this rich region of our country.

KUZNETSK BLAST FURNACE WORKERS

D. A. Shtyrev, Deputy Head of Blast Furnace Plant
I. A. Suchkov, Senior Foreman of Technological Group
V. M. Minkin, Head of Blast Furnace Laboratory TsZL

The first batch of Kuznetsk pig iron (blast furnace metal) was produced 23 months after the construction of the metallurgical combine began, i.e., on April 3, 1932. Three months afterwards the second blast furnace started operation, and on December 21, 1934 furnace No. 4 was blown in. Thus the construction of the blast furnace plant was completed, comprising four, for that time, powerful blast furnaces with a total effective volume of 3968 m^3.

From 1932 to 1937, because of the absence of adequate experience in the process working and the lack of experience in use of equipment, these powerful blast furnaces frequently stood idle, their working was irregular and the absence of crust in the furnaces was rather a rare exception. The iron ore was not properly prepared, the methods of blasting and of charging to provide the optimum distribution of materials in the furnace was not developed and the charge was not adjusted according to flue dust carry-out.

In 1940 the personnel of the plant had solved several technological problems. The blast furnace operators learned to control the furnace working from above, succeeding in ensuring constant blasting and temperature conditions, began to adjust the charge according to the entire dust carry-out, changed the construction of the furnace guards and mastered the shutting of tapping hole at full blast. A regular working of furnaces was achieved by a careful preparation and handling of the charge materials in the ore yard, in the hopper and during the charging of the furnace while the thermal conditions of the furnace were kept strictly constant by means of variation of the ore load per ton of coke. The adoption of these methods and the introduction of several technical and constructional modifications made it possible to improve the working of the furnaces and shorten their idle periods. Only ten years after all the furnaces of the Combine started operation, the coefficient of utilization of the effective volume was raised by 26%.

During the war years the Kuznetsk blast furnace workers were working with enormous patriotic enthusiasm, performing successfully the tasks set by the State Defense Committee.

The regular and steady technological system of operation, adjusted before the war, facilitated the improvement in the utilization of production capacities. The coefficient of utilization of the effective volume of the blast furnaces of the Kuznetsk Combine was reaching 0.81-0.83 (in some months 0.76).

In All-Union socialist competition the blast furnace plant of the Kuznetsk Combine has won 25 times the Challenge banner of the State Defense Committee and was given this Banner for safe-keeping in perpetuity. The Soviet Government has highly esteemed the production achievements of Kuznetsk blast furnace workers during the Patriotic War and has rewarded a large group of the leading workers of the plant with orders and medals.

The first post-war Five-Year Plan has been fulfilled in three and a half years. The production of pig iron increased by 40%. The plant personnel had such achievements owing to the introduction of technical innovations, first of all as a result of successfully adopting the gas flow control by means of changing the system of furnace charging, by taking active steps against the freezing of raw materials, by the automation of the blast furnace charging, by speeding up the repair work on the furnaces and by prolonging their runs.

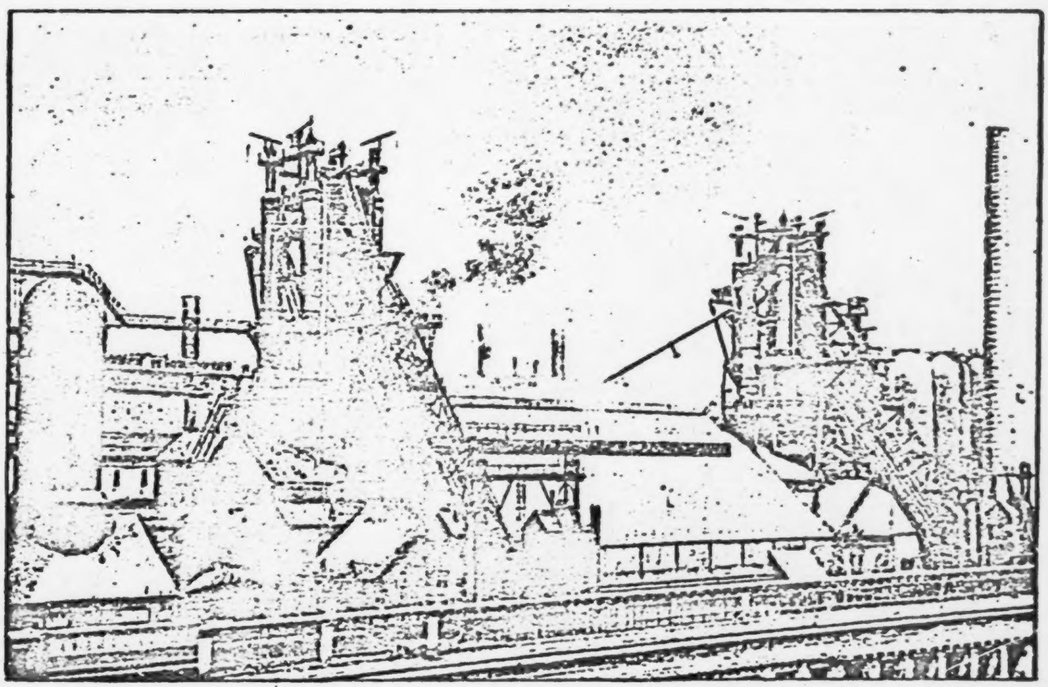
New improvements in the technology of the blast furnace process were developed and introduced; furnace operation with the blast of constant and higher humidity and smelting of iron of low manganese and phosphorus content were adopted.

The application of the blast of constant and higher humidity resulted in steadier furnace operation. The performance of the furnaces improved: for each 10 g/cu. m. of artificially introduced moisture the increase in productive capacity amounted to 4%, the consumption of coke fell by 1%, the productivity of furnace operation by 2.8%, and the cost of 1 ton of pig iron decreased by 70 kopecks.

The lowering of the manganese and phosphorus content in pig iron was accomplished by gradual reduction in use of Mazulsk manganese ore and open-hearth furnace slag terminating in their complete exclusion from the charge. On lowering the manganese content in pig iron from 1.7-1.8 to 0.45-0.55% the furnace output increased by 5.4% and cost of pig iron per ton decreased by 9 rubles 16 kopecks. The phosphorus content in pig iron decreased from 0.27-0.25 to 0.15-0.14%. At the same time the iron content in pig iron increased by 1.30-1.35%. The required desulphuration took place on account of the increased basicity of furnace slag ($CaO : SiO_2$) from 0.98-0.99 to 1.05-1.06.

The plant completed also the fifth Five-Year Plan with a great success. The increase in pig iron output amounted to 25%, the coefficient of effective volume utilization reached 0.726 in the last year of the Five-Year Plan. This showing has been achieved by further adoption of new techniques and technology, by the intensification of blast furnace smelting, by the automation of production processes. The workers of the plant have mastered the furnace operation with blast of constant humidity and with an increased gas pressure.

The application of fluxed agglomerate and the modernization of some furnaces by increasing their effective volume to 1310 cu. m. have resulted in a substantial increase in productive capacity. Plant operation experience has shown that the essential condition for a more efficient utilization of the effective volume is the proper preparation of raw materials.



Beginning in November 1950 the increased gas pressure was adopted successively in all the furnaces of the plant. In the operation of the furnaces with an increased gas pressure the most important factor was the determination of the optimum conditions of charging operation. The decrease in volume of gas resulting from its increased pressure was accompanied by lowering of its velocity which, in turn, was causing an excessive

Lukyan Viktorovich Silitsky, who started work at the construction of the Combine in 1931, is one of the best furnace attendants.

Senior gas worker, Honorary Metallurgist, Vasily Vasilyevich Balta is held in high esteem by the blast furnace community His work has been acknowledged by high state prizes: Order of Lenin, Order of the Red Banner of Labor and by several medals. For his high productive achievements in socialist competitions the name of V. V. Balta was entered into the Combine's Book of Honor.

Among the blast furnace workers a high productive efficiency in the so .ialist competition has been attained by the personnel of the blast furnace No. 1 where comrades Pospelov, Ashpin, Pershikov are working as foreman and Inyutin, Silitsky and Starkov as furnace attendants. In 1956 they produced 5930 tons of pig iron over and above the plan, achieved the 0.68 coefficient of the effective volume utilization of the furnace and saved 1,300,000 rubles value of state resources. (Right B. I. Ashpin, left A. D. Pospelov).

F. R. Popov has attained well-earned prestige by his excellent work as the first furnace attendant of No. 3 blast furnace.

Communist Ivan Aleksandrovich Antropov who started work as a manual laborer 20 years ago, works selflessly in the blast furnace plant. Having mastered one of the basic trades, he has been working for 17 years as a scale-car engineer. For his irreproachable work Ivan Aleksandrovich has been rewarded with the Order of the Red Banner of Labor, three medals and the title of Honorary Metallurgist.

development of the peripheral gas stream. Only by a proper adjustment of the system and conditions of charging it was possible to attain a normal gas distribution in the furnace and steady and efficient operation.

As a result of increasing the pressure of the blast furnace gas to 0.55 atm. approximately, an increase in the efficiency of the blast furnaces by 7.4% was achieved, coke consumption was lowered by 0.9% and the smelting rate increased by 6.5% (on the basis of daily coke consumption).

The personnel of the plant fulfilled the 1956 plan on time, on December 30, and gave the country some thousands of tons of iron over and above the plan, saving 3.8 million rubles value of state resources. Merely by the rationalization and the development of inventions 700,000 rubles were saved. The planned increased operating efficiency was exceeded by 1%. In comparison with 1955 the level of pig iron production has risen by 7.8%.

The coefficient of utilization of the effective volume of the blast furnaces in 1956 averaged over the plant at 0.695 (0.70 planned) and increased by 20.1% compared with 1950, and the coke consumption per ton of pig iron decreased by 17% reaching in 1956 726 kg. The output of pig iron in 1956 increased by 26.5% compared with 1950.

On the results of socialist competitions for the fourth quarter of 1956 the plant received the title "Outstanding Blast Furnace Plant of the Soviet Union."

The Kuznetsk metallurgical Combine accomplished for the first time in the Soviet Union the complex automation of the scale-car. The automation here comprises: transport of scale-cars, loading and weighing of material according to the schedule of the charging cycle and unloading of the charge from the scale-car. The material is unloaded into a skip or into an intermediate hopper, only under the conditions of a full delivery and closed emptied intermediate hopper.

The automation of the scale-car operation relieved the machine operator of heavy work under conditions very detrimental to health, secured a speedy loading and increased the accuracy of weighing of charge materials.

A remarkable political and technical advancement of the personnel in the 25 years of the operation of the plant has to be acknowledged. Many experienced, qualified workers of the Combine who went through its production training, were transferred to assist other plants. To a great extent this development of specialists is due to a wide-embracing technical education.

More than 50 plant workers attend courses for foremen, schools for working young people, plant societies for the study of new techniques, evening departments of metallurgical technical schools and institutes.

Some remarkable personalities have developed in the plant, such as e.g., V. G. Guryanov who joined the plant as an electrician in 1931. Now he is in charge of the electrical installations of the plant. On his initiative and under his supervision a complete automation of loading and weighing raw materials and charging of blast furnaces, and the automation of air heaters was accomplished.

L. V. Silitsky, who began his working career as a laborer on the construction of the Combine was honored several times with the title of "Outstanding Furnace Attendant of the Soviet Union." In 1956 he produced 1888 tons of pig iron over and above the plan.

In a short time after completing a trade school A. S. Nechai has mastered the complex trade of chief furnace attendant.

A. I. Dogadaev who joined the plant as a laborer became a good blast furnace foreman.

General respect and prestige is enjoyed by comrades A. D. Pospelov, Ermachenko, Martynov, Gerasimov, who have been in the plant for over 20 years.

A tireless innovator, E. V. Kuznetsov, who joined the plant 23 years ago as a fitter, is now in charge of a complex section of equipment repairs. During the fifth Five-Year Plan only, he proposed 36 innovations. The adoption of these innovations saved the plant 70,000 rubles.

Remarkable successes have been achieved by the No. 1 Blast furnace personnel who produced 5930 tons of pig iron over and above the plan. A. D. Pospelov, B. I. Ashpin and P. V. Pershikov are working here as foremen and L. V. Silitsky, P. E. Inyutin and P. A. Starkov as first furnace attendants.

The plant personnel has outlined several measures with a view to fulfill the 1957 plan ahead of time. These are: further improvement of the technology of furnace operation in connection with the changed condition of raw iron ore quality, shortening of idle periods of furnaces by the improvement of installations, speeding-up and improvement of the quality of repairs and the completion of the automation of charging and the automation of blast heating of all furnaces. The automatic control of the gas stream in the furnace by means of a variation of the operation of the rotary distributor, controlled by the pickup instruments recording the temperature of the furnace in several points, has also been projected. The automation will make it possible to change the scheme of loading, the level of the charge and the size of the coke charge, according to the change of the gas stream in the shaft. At the same time the drop in the gas pressure at different levels will be taken into account. It is planned to introduce in 1957 the automatic control of the descent of the materials in the stack according to the drop of the static gas pressure on different levels in the furnace.

In connection with the automation of operations, special attention is being paid to the technical training of operating and, in particular, of maintenance personnel.

The plant personnel giving initiative to socialist competition, pledged themselves to produce in 1957 8000 tons of pig iron over and above the plan.

While noting the achievements, the blast furnace workers do not, for one moment, forget the still existing shortcomings in the working of the plant. There are still unutilized capabilities; not all the furnaces are working evenly, without idle periods; there are cases of breach of industrial discipline and not everything has yet been done to reduce the amount of rejected material.

The utilization of capacity to the maximum, general adoption of new techniques, constant improvement of the technology of processes and the organization of work — these are very important tasks for the blast furnace personnel.

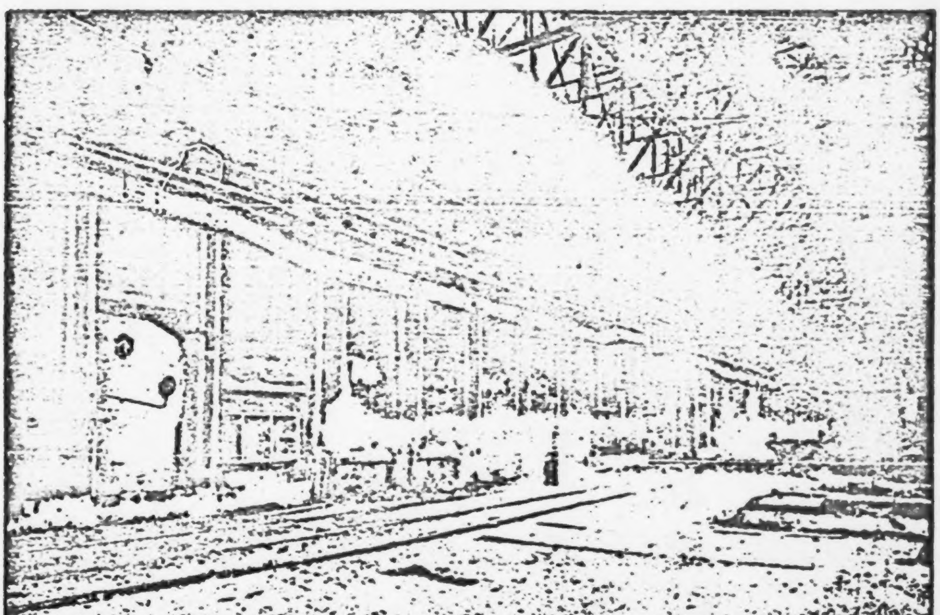
WE SHALL PRODUCE 7000 TONS OVER AND ABOVE THE PLAN

N. A. Shestakov

Deputy Head of the Open-hearth Furnace Plant No. 1

In 1932 the first steelmaking took place in No. 1 open-hearth furnace. In the pre-war years the Kuznetsk Metallurgical Combine supplied with metal the main projects of the Five Year Plans. At the same time these were the years of mastering the complex steel-manufacturing processes by the former builders and constructors of the Combine, who took over the metallurgical operations.

The workers of the No. 1 open-hearth plant have been continually raising the output of steel by improving the organization of production and utilizing existing capacities, by the adoption of new improvements in the construction of open-hearth furnaces and in the gas furnace thermo-techniques, by the modernization of technology, by improving quality, by shortening the idle periods of furnaces during hot and cold maintenance works, and by increasing the life of open-hearth furnaces.



For the high productive efficiency during the fourth quarter of 1956 the No. 1 open-hearth furnace plant was awarded the title "Outstanding Steel Plant of the Soviet Union" and received the Challenge Red Banner of the Council of Ministers of USSR and VTsSPS.

To improve the system of charging of the open-hearth furnaces, the charging boxes of 1.25 cu m capacity (instead of 0.9 cu m) were introduced, and this year it is proposed to introduce 1.75 cu m capacity boxes; this, together with a coarser separation of scrap (500 x 500 x 500 mm), will result in cutting the time of charging and hence speeding-up the steelmaking. The adoption of the large volume charging boxes requires reinforcement of the means of loading.

A change-over from Dinas (silica) refractory furnace roofs to the basic magnesitochromite thrust roofs was initiated in '49. In 1953 the change-over to the basic roofs of thrust-suspension construction was completed, and this made it possible to increase the durability of open-hearth furnaces very markedly. Previously their durability amounted on the average to 226 steelmaking operations; after the change-over to the roofs of thrust-suspension construction the durability reached 344 runs. After the complete change-over of all the furnaces of the plant to the roofs of new constuuction in 1956 the durability amounted to 564 runs, while for furnace No. 5 it was 762 runs and the larger capacity furnace No. 1 it was 522 runs.

The transition to the all-basic furnaces made it possible to increase the heat liberation per unit volume of combustion space. At the same time it was, however, necessary to reinforce the tractive means. In the course of 1953-1954 the stacks of furnaces Nos. 1, 2, 3, and 4 were extended from 65 to 80 m and ventilators were installed on the common motor shaft which made it possible to increase vacuum by 10 mm water gauge. The high temperatures obtained in furnaces required a reinforcement of the furnace bases and especially of the checkered brickwork. Therefore in the course of 1953-1955 the upper rows of the checkers were begun to be laid out with the forsterite refractory.

For the improvement of the flame open-hearth furnaces and for a better utilization of fuel, an injection of compressed air into gas caisson was introduced on all the furnaces in 1953. As a result, the consumption of conventional fuel per ton of steel was, in the average over the whole plant, 148.1 kg in 1951; 145.3 in 1953 and 143.1 kg in 1956 (excluding the losses during the gasification in the gas works).

Within five years a marked decrease in the idle time of furnaces was achieved. The idle time on floor repairs in 1956 amounted to 0.58% in the first block and 1.68 in the second.

Year	Steel output % (referred to 1951)	Idle time, %		Output of steel per 1 sq. m furnaces floor space /24 hrs, in tons	Time of smelting operation, hours	Output per worker, tons
		per year	referred to 1951			
1951	100	7.34	100	7.22	11.41	—
1952	103.9	6.21	84.6	7.52	11.29	146.1
1953	109.6	7.5	102.2	7.76	11.27	149.7
1954	114.9	6.81	92.8	8.14	10.51	154.4
1955	120	6.21	84.6	8.57	10.32	161.6
1956	130.1	5.39	73.4	9.19	10.50	173.2

Senior foremen Privalov and Mogilevtsev have contributed a great deal to these achievements. The table above shows the data regarding the idle periods of open-hearth furnaces during maintenance.

The personnel of the plant in cooperation with the Central Laboratory and the Siberia Metallurgical Institute have achieved great improvement in the technology of steel production through shortening of the steelmaking time and the savings in raw and subsidiary materials. Research has been carried out on the reduction of rails and stamp metal without blast furnace ferrosilicon, on the reduction of effervescent steel in the ladle, on treatment of low alloy-content metal in large furnaces and some other problems, the results of which have now been applied to the production processes.

All this allowed the plant personnel to increase steel output year by year and also to lower the steelmaking time and raise the operating efficiency.

The data given in the table illustrate the increase in steel output from 1951 to 1956.

In the fourth quarter of 1956 10,450 tons of steel over and above the plan was produced, the output of steel per 1 sq. m. of furnace floor reaching 9.35 ton. Idle time of the open-hearth furnaces fell to 4.5%, the rejects were reduced by 25%, and the operating efficiency increased by 7.9% compared with 1955.

The personnel of the No. 2 open-hearth furnace headed by the steelmakers, communists, Honorary Metallurgists Kuznetsov, Burkatsky and Shabalov has produced in 1956 9330 tons of steel in excess of the plan and completed the annual schedule two weeks ahead of time.

For their outstanding production achievements in socialist competition, the names of the steelworker comrades Burkatsky, Kuznetsov and Shabalov have been entered into the Book of Honor.

On the left M. T. Kuznetsov, on the right K. F. Shabalov.

The casting bay of the open-hearth plant No. 1.
(Photo L. Vilner).

Among the foremost men of the plant the operators of the large open-hearth furnace No. 2, comrades Kuznetsov, Shabalov and Burkatsky are outstanding, having fulfilled the 1956 state plan by December 16, achieving an output of 9.85 tons per sq. m. of floor space, having lowered idle time to 5.66%, and shortened

the time of steelmaking by 3 minutes compared with previous year. This co-operative community year by year increased the rate of output. In 1956 their steel output was 21% higher than in 1951.

Great effort by the plant to improve the quality of metal resulted in a sharp decline in rejected material. Final rejected material in 1951 constituted 1.039% of the annual metal output while in 1956 it constituted 0.549%, i.e., was 47% lower.

Serious attention is paid to the problem of production cost. In 1956 the plant saved 722,000 rubles. Considerable savings have been attained by careful use of ore, of metal charge, of magnesite and other materials.

Our outstanding innovators have played an important part in the increase of output and in the mechanization of labor-consuming processes. From 1951 to 1956 718 innovations have been proposed. Total savings resulting from the adoption of the innovations amounted to 4,492,906 rubles.

The foreman-technologist, Nikitin, has simplified the technology of dynamo steelmaking by proposing the reduction of metal in the ladle instead of in the furnace; senior foremen Mogilevtsev has modified the method of burning-in, mechanizing it by making use of the charging machine; foremen Prudnikov and Esin have changed the technology of dephosphorization; mechanics Evstigneev, Burtsev and Musatov, made several proposals with regard to easing the workers' labor. General familiarization with the experience of leading men and innovators is considered of great importance on the plant. Hence the operating experience of charging machine operators comrades Markov and Alimovsky, of casting operator comrade Plotnikov, of charge foreman Artemenko, of ladle operator Kozin, of No. 2 furnace operators comrades Burkatsky and Kuznetsov, of senior foreman Privalov and of many others, was studied and discussed.

With the growth of the plant grew the cadres of metallurgists. The steelworker, comrade Chalkov, was working on the construction of the open-hearth furnace plant a quarter of a century ago; the operator of the distribution crane, comrade Golovin, was on the construction of the mixer; the steelworker, comrade Kosolapov, began his work as a loader; Member of the Supreme Soviet of USSR, comrade Privalov, has worked his way from an apprentice to a senior foreman. The senior foreman of the casting bay, comrade Danilov and foreman comrade Ulybyshev, began their work as cinderpit men in the plant. Credit is due to the loaders, comrades Koshel and Lyubkin, to the steelworkers Baev, Rukin, Tokarchuk, Belyaev, to the mixer operator Melnikov, gas operators Strubnev and Chernykh, to the distribution crane operators Shornikov, Samoletov, Golovin and Selyuk, to the charging crane operators Chueva and Pinaeva, to the loading machine operators Korinov, Alimovsky, N. Ivanov, to the ladle operators Kozhekhmetov, Plotnikov, Vorontsov, Karanevsky and Vilba.

There are more complex tasks before the personnel of the plant in 1957 than in 1956. In January 1957 the plant had not coped with the allotted task and had not fulfilled the state plan. This was due to the delivery of inadequate supplies of first class ore and scrap to the open-hearth steel plant. The furnaces were supplied with low iron content ore containing large quantities of fines and silica which hampered the operation of the furnaces and lowered their efficiency. Scrap received by the plant is unsatisfactory; it is too light and gives trouble in charging.

The Ministry of Ferrous Metallurgy is faced with the urgent solution of problems of high-grade ore supplies for open-hearth furnace plant and of installation of powerful piling presses for the light-weight scrap.

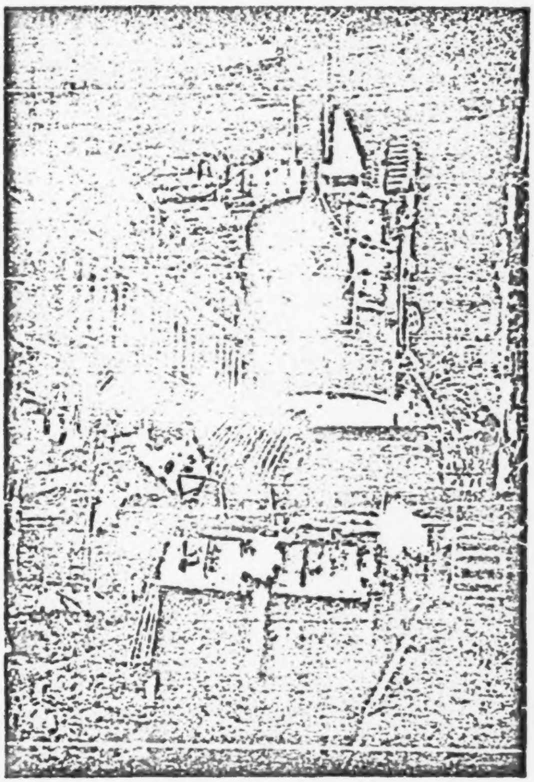
The personnel of open-hearth furnace plant No. 1 is full of energy and enthusiasm. During 1957 the steelmakers will cope with their task and will fulfill their socialist pledges: to produce 7000 tons of steel over and above the plan.

ON THE WAY TO FURTHER SUCCESSES

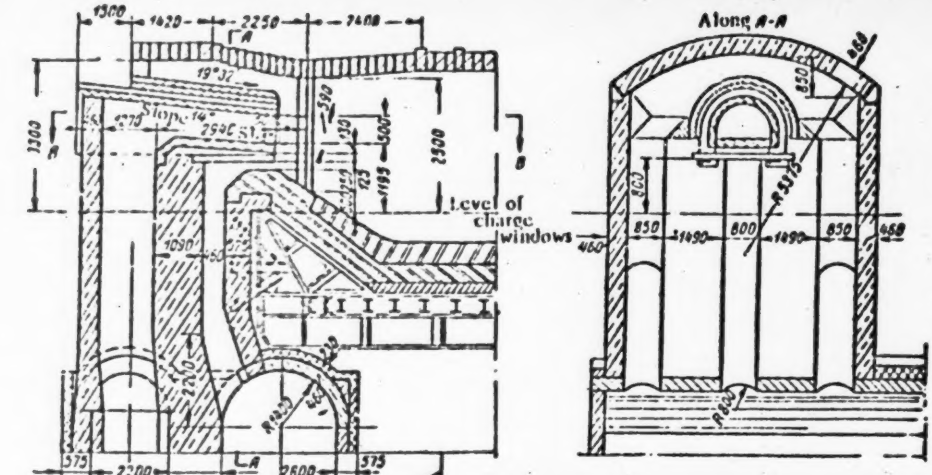
M. B. Zilbershtein

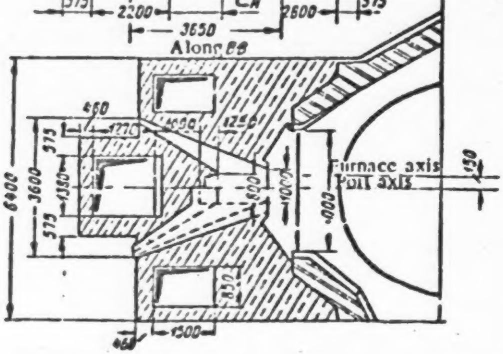
Head of Open-Hearth Furnace, Plant No. 2

The personnel of open-hearth steel plant No. 2 has been consistently improving the production efficiency year by year. Over the last 15 years the output of steel in the plant has increased by 72%; while the increase in productivity of small furnaces has been 57.2% and that of larger furnaces has been 52.2%.



During the Great Patriotic War the production of reliable alloy steels for defense needs was rapidly developed and carried out in the main large-capacity open-hearth furnaces. A new technology of steelmaking and casting had to be developed, the organization of production had to be changed to a considerable extent in all sections of the plant, as only carbon steel had been produced previously.





Port end of 350-T. Open-hearth furnace.

The steelworkers have completed their task with flying colors. In the All-Union socialist competition the personnel of the plant was several times awarded the Challenge Red Banner of the State Defense Committee.

During the post-war years the plant has been raising production continually. The steel output envisaged in the fourth Five-Year Plan was reached in three years. In the fifth Five-Year Plan 128,320 tons of steel were produced in excess of the plan.

The personnel of the plant works with even a greater enthusiasm at the present time: in 1956 the plant reached the highest level of production since it started operation and produced 15,800 tons of metal over and above the annual estimate.

TABLE 1

The Rise in Steel Production and Operating Efficiency of the Plant

Year	Steel output, % referred to 1951			Operating efficiency per worker	
	Whole plant	Furnaces: Small	Furnaces: Large	t	% referred to 1951
1941	100	100	100	172.0	100
1943	98.4	95.3	101.1	148.4	86.3
1945	104.8	98.7	111.3	145.1	84.4
1947	107.9	109.7	106.0	172.6	100.35
1949	121.8	124.0	119.5	213.14	124.0
1951	130.1	134.7	125.8	224.05	130.27
1953	143.9	138.2	134.4	239.5	139.3
1955	160.9	154.2	150.4	256.3	149.0
1956	171.9	157.5	152.2	270.3	157.2

T A B L E 2

Operating Efficiency of the Plant Furnaces

Year	Average batch weight		Average smelting time, hrs-min.		Idle time, %		Consumption of conventional fuel kg/t	Durability of magnesitochromite crowns, runs	
	Furnaces		Furnaces						
	Small	Large	Small	Large	Total	On hearth repairs		Small furnaces	Large furnaces
1941	172.0	310	11—25	13—22	15.03	4.80	172.2		
1943	185	308	12—38	12—23	17.2	4.32	217.4		
1945	187	329	12—42	12—35	15.02	3.80	195.9		
1947	190.1	330	11—43	13—05	15.94	3.1	178.9		
1949	190.1	355.4	11—04	13—00	11.28	2.6	155.7		
1951	190.5	366.5	11—25	13—04	8.96	2.04	152.7		
1953	191	370.6	9—48	12—29	8.83	1.67	152.7	423	301
1955	190	375	9—07	11—38	7.28	1.98	143	627	481
1956	191.1	382.2	9—07	11—41	6.88	1.49	139.8	629	469

The very rapid growth of steel production and the increase in productivity per worker in open-hearth furnace plant No. 2 during the last fifteen years are illustrated in Table 1.

The increase of steel output was achieved on the existing furnaces without construction of new units. The workers, while raising the batch tonnage, particularly in the large furnaces, were at the same time cutting down the time of run and the idle time on maintenance. These achievements were made possible by the use of high-quality refractories in the upper and lower structure of the furnaces, by improving the thermal efficiency of furnaces by means of modification of the structural dimensions of the port ends of the furnaces (see diagram), by intensifying the heating of gas and air checkers, by the adoption of appropriate thermal conditions, by improving the furnace maintenance, by tightening the industrial discipline of the personnel and by the measures taken with regard to the mechanization of furnace maintenance operations.

Operating efficiency of the plant furnaces is illustrated in Table 2.

Efficient operation of the plant, viewed as a whole, depends not only on the operation of the furnaces themselves but also on the regular functioning of the other subsidiary sections of the plant: the charge yard and mixer, the casting bay and the batch preparation section. Great care has always been taken to synchronize the work of all sections with that of the furnaces. This again depends on efficient organization of production and on the maximum utilization of the existing installations in the sections. Our plant is not over-equipped: in the charge yard, eight furnaces are served by three 10-ton charging cranes (hot blast furnace metal constitutes 63-64% of the charge); for the loading of a large furnace 3.5 batches of scrap, and for a small one 2 batches are required. In the furnace bay there are two hot metal charging cranes, in the casting bay there are 5 ladle cranes and 15 steel ladles for 13 troughs.

The furnaces' idling through the fault of the plant was insignificant. Thus the idle time of the furnaces over the last two years was, hrs-min:

	Year	
Through shortage of:	1955	1956
charge	6-40	21-30
pig iron	99-15	48-05
steel pouring ladles	20-15	23-25
slag cups	19-00	24-10
casting equipment	9-50	4-35
Through idling of plant on maintenance	107-35	54-10

Considerable innovations were adopted in the technology of steelmaking and steel casting. The assortment of steel produced by our plant is fairly wide: carbon steel (effervescent and killed): tool steel U10A and U12A; chromium, nickel, molybdenum and vanadium alloy steel, special steel (dynamo steel ShKh15, KhO5) and others. In the course of several years the basic guiding principle in the technology of steel-making and casting was worked out: namely a minimum content of harmful additions of sulphur and phosphorus, optimum chemical composition of given elements and purity of the metal with regard to nonmetallic impurities and gases. We attained these conditions first of all by maintaining correct conditions of the slag. A forced running-off of the slag by means of a charging machine is strictly applied and so is the treatment of new slag with lime and bauxite; on making high-grade steel, new slag is treated with special slag mixtures.

Since 1954 the use of low manganese content pig iron has been adopted without any lowering of metal quality. A two-tap steel casting has been introduced.

The total amount of final rejected material relative to the total steel output declined from 0.81% in 1950 to 0.549% in 1956.

The amount of metal rejected by consumers declined from 149 tons in 1954 to 48 tons in 1956.

The plant personnel succeeded in improving the economy of production. The overall cost of the cast iron for steel manufacture, this being the most important index illustrating that part of production cost which entirely depends on performance of the plant itself, fell from 62 rubles to 84 kopecks per ton of steel in 1951 to 53 rubles 26 kopecks in 1956.

The remarkable personnel form the basis of the successful plant operation. Graduate of FZU, G. N. Vetrov, has advanced from an apprentice smelter to a foreman-technologist. After completing the foreman course in 1956 he is preparing now to enter a technical school. Examples of highly productive efficiency have been provided for many years in succession by the work of the steel workers, comrades Nekhoroshev, Kuzin, Zhuravsky, Bedashchuk, Nazarenko and Kopylov, and the steel workers of the Comsomol-Youth Furnace, comrades Konyakin, Khvorov and Sinitsyn. Many of them were repeatedly awarded the title "The Outstanding Steel Worker of the Soviet Union."

N. N. Vetrov has advanced from being a laborer on the construction of the Combine to becoming foreman of the water supply and distribution system. The adoption of his innovations saved the plant more than 1,500,000 rubles.

Comrades Sadykov and Serebryannikov who were working as diggers on the construction of the plant, have now been working for many years as foreman on furnaces and casting.

The advancement of personnel depended to a great extent on the continuous technical education of all the workers in leading trades.

Open-hearth plant No. 2 has covered a long road in 25 years. But the steel workers will not be complacent on account of the past achievements. There are still production shortcomings which have to be eliminated. These are, in particular, the irregular operation of separate sections of the plant, unsatisfactory quality of metal surfaces, and others.

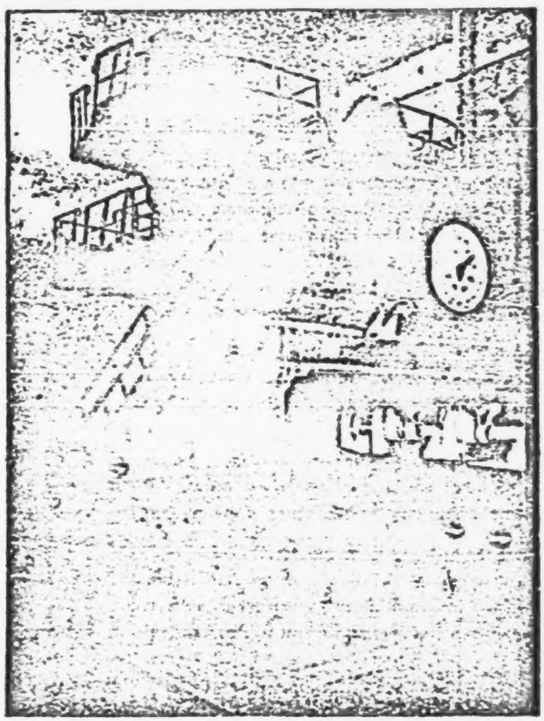
There is no doubt that the united personnel of the plant by surmounting these shortcomings will succeed in attaining further records in 1957, the second year of the sixth Five-Year Plan, and will give the country thousands of tons of high-quality metal over and above the plan.

THE LEADING MILL

B. P. Zuev

Deputy Head of Finishing Plant

The first batch of ingots was rolled at the Kuznetsk Blooming Plant on November 7, 1932. The start of operation of the blooming plant completed the metallurgical operational cycle of the first undertaking of ferrous metallurgy in the eastern part of our country.



The personnel of the plant has achieved a high level of productivity over the past years. The designed output of the mill was attained in 1937 and was more than doubled by 1956. These achievements are the results of the efforts of many years towards improvement of equipment, of technology and of production organization.

Special attention is paid to the increase of the temperature of ingots on delivery as on this temperature depends the efficiency of pit furnace fuel consumption and the quality of ingot heating (Table 1). A strict time schedule of operations is adhered to: the time taken from the completion of casting to the introduction of ingots to the pit furnace is 55 minutes for effervescent steel, 2 hours for killed high quality steel and 2 hours

25 minutes for rail steel. The schedule made it possible to raise the temperature of furnace charge and lower the fuel consumption.

The blooming plant has 12 groups of regenerative heating furnaces each consisting of 4 compartments which are capable of accommodating six ingots each. The ovens are heated with blast furnace gas and coke gas. Each group has a common stack and a common vent switch; every two compartments have their damper.

In the Kuznetsk Combine was introduced, for the first time, the fluid slag removal with a continuous slag discharge. The output of each group has doubled as compared to the earlier work with dry slag, manpower requirements were reduced by 18 workers and as a result of eliminating nonproductive losses, a 2.5%-3% saving in fuel was achieved.

From 1948-1950 onwards the heating conditions of ingots in all pit furnaces have been automatically controlled. It was not possible, however, to make the heating process fully automatic because of the difficulties of registering the true ingot temperature resulting from the constructional defects of furnaces. Therefore the delivery of heated metal and the change-over from the period of intense heating to the period of soaking are carried out by an operator.

The pit furnaces have been, and still are, a bottleneck of the plant and therefore the method of heating is marked by a very high rate of temperature rise in the first period and a short total heating time. For ungraded steel a method of short-time heating, developed and introduced on the initiative of the innovators, comrades Borysenko, Frantsuzov and Kuchayev, is applied. In this case the heating time is cut down by 13-15% and amounts to 1.5-2 hours.

In 1951, in order to accelerate the heating of cold ingots, heating by means of blast furnace gas and coke gas was adopted. The addition of 7-8% of coke gas, by raising the calorific value of the mixture to 1190-1220 cal/cu. m., made it possible to shorten the heating time of cold ingots of effervescent steel by 10.6% and that of killed steel by 6.4%. At the present the mixed gas is used also for the heating of hot ingots of low alloy content and ungraded steel.

The efficiency coefficient of pit furnace reached 0.793 in 1956 while the number of runs of a group per 24 hours reached 6.55; the reserve capacity of the pit furnaces constitutes 1.15, this being quite inadequate for the blooming mill operation.

The method of ingot rolling in the blooming plant of our Combine is an original one and differs markedly from the methods of other blooming plants. There are two reversible two-high mills in the plant, arranged in a line at a distance of 100 m one from the other: a large blooming mill with 1200 mm diameter rollers and a small one with 950 mm diameter rollers. 320 × 330 mm blooms and 140 × 650 - 200 × × 700 mm slabs for rail-rolling mill, section mill and sheet rolling mills, are rolled on the blooming mill 1200, and the blooms and slabs of smaller cross section for the medium grade and medium sheet mills are rolled on the 950 mill. Rolling is done without intermittent re-heating.

TABLE 1

Year	Number of ingots, in %, entering the pit furnaces at temperature °C						Average temperature °C	Fuel consumption kg/t	
	Cold	300-600	600-700	700-800	800-900	900-1000		planned	actual
1954	3.1	2.4	3.2	16.3	60.3	14.7	818	43.6	44.7
1955	4.9	2.2	4.1	26.0	60.2	2.6	832	44.1	42.2
1956	3.6	2.9	3.8	23.4	62.0	4.3	834	41.0	39.8

In 1956 the Team No. 3 of the Finishing Plant turned out 27,345 tons of rolled metal over and above the plan. Senior machine operator in this team, Mikhail Afanasyevich Merkulov began his working career as a laborer on the site in 1931. By enriching constantly his knowledge and experience he advanced to a machine operator in the blooming plant. For his irreproachable work he was awarded the Order of Lenin, two Orders of the Red Banner of Labor, and a Medal and the title of Honorary Metallurgist.

The team leader of Finishing Plant fitters, N. F. Yakovenko introduced many a valuable innovation (on the right).

TABLE 2

Operation	Prior to modernization	After modernization
Maximum speed of roller displacement, mm/sec.	75	110
Time of full raising of upper roller, sec.	8.15	4.70
Speed of roll-train, m/sec.	1.50	2.55
Speed of manipulators, m/sec.	0.72	0.68
Acceleration of roll-train, m/sec^2.	0.54	1.38
Acceleration of manipulators, m/sec^2	0.40	0.75
Final speed of ingot carriage, m/sec.	5.0	6.5
Time of ingot carriage acceleration, sec.	17.0	7.4
Time of retardation of ingot carriage, sec.	12.0	6.1
Cutting time of shears, sec.	12.5	10.0

Rail rolling and structural steel mills have their own blooming lines. There is no need, therefore, to roll the material down to small section in the 1200 mill. Most of the ingots are rolled in eleven runs with three canting. The first three reductions amount to 60-70 mm, the following seven amount to 100-140 mm.

The adoption of large reductions makes the gripping of metal by the rollers more difficult and therefore the operators usually slow down the main drive at the moment of gripping. Since 1955 the knurling of rollers has been adopted which increases the coefficient of friction between the rollers and metal and facilitates the gripping.

As there are several billet mills after the blooming, it is necessary to deal simultaneously with two or three batches from open-hearth furnaces. According to the present system, the scheme of rolling is varied after each

ingot and this affects negatively the overall rate of production of the mill and complicates the operation of mechanical equipment.

In the course of plant operation the personnel of the plant carried out considerable modifications in the construction of main machinery.

In 1948 the senior electrician of the plant Yu. V. Mamkin developed and applied a voltage regulator to the generators circuit, which resulted in an increase in the productivity of blooming plant by 40%.

Anastasiya Ivanovna Pinzhina has worked for over 20 years on the rolling plant, advancing from an unskilled laborer to a shears machine-operator. She has been awarded the Order of the Red Banner and two medals. The director of the Combine has thanked her on many occasions for her high efficiency.

The ingot carriage of very unsatisfactory construction, has been remade and converted from sliding bearings to rolling bearings of needle-shape type, worn gear has been replaced with a helical gear, a spare ingot carriage has been constructed and a system of runways, allowing carriage change in 10 minutes, has been laid.

In 1956 the ingot carriage was again radically modernized: all slides were converted to power-drive and the velocity raised to 7 m/sec. On the initiative of the plant mechanic A. I. Konovalov, the equipment engineer D. V. Stupin and team-leaders A. I. Krasnobaev and N. F. Yakovenko, the friction rollers of the blooming mill and the gear module of the roll train have been changed; this resulted in complete elimination of idling in this section.

When the plant was erected, no provision was made for the roller changing equipment. Engineer A. E. Frolov and Foreman N. T. Kostyukov have constructed a roller changing machine which saves labor and reduces the time of roller changing by two hours.

The change-over of the blooming mill to the rectangular ingots of killed and effervescent steel in 1948-1950 made it possible to reduce the number of passes by two and reduce the time of heating by 20 minutes. The operating procedure of the most experienced mill operators, P. V. Zavarykin, I. A. Somov and M. A. Merkulov were studied in 1951. Following the analysis of the time recordings of the operations and of oscillogram of the rolling, a most efficient method of ingot reduction was adopted: the operation at low speed on engagement and injection with highest possible steady speed.

This method was taken as a basis of the operation, and after supplementing it with operational methods of other workers at the rolling mill, it was adopted in the plant. The change-over to the high speed method by all the operators made it possible to cut down the time of rolling and increase the output of the plant. The adoption, in 1952, of the methods of the rolling mill operators made it possible to change to the rolling with high reduction of two main types of ingots and has consequently reduced the number of passes by 2 and the total cycle of ingot working by 10-12%.

Any further increase in plan production has been limited by the obsolete design of auxiliary equipment (press equipment, roll-trains, ingot carriages and shears).

Therefore a modernization of mechanical and electrical equipment by changing to the generator-motor system has been carried out. The reducing gears of the pressing equipment have been modified and the worm gear replaced by helical gears.

Based on the modernization in 1953, the automation of rolling operations in the blooming mill has been introduced. The automation includes the delivery of ingots to the gripping, looping and working roll-trains of the blooming mill and the operation of the main drive and press equipment according to 12 alternative schemes of rolling. The automation has been introduced since May, 1954, and it is utilized in some months up to 65-75%.

Fully automatic operation is impeded by the large number of different types of ingots worked in the blooming plant and by somewhat lower productivity compared with manual operation, which indicates an insufficient mastering of some individual units of automation.

In Table 2 a comparison of the operation of main blooming units before and after modernization is given.

In 1955-6 the receiving roll train was extended to the section of soaking pits and a fifth soaking-pit crane was installed. These modifications made it possible to reduce idle periods due to delay in the ingot delivery, by as much as 40% in 1956.

At the present time further work is being done regarding the increase of the weight of ingots. In 1955-1956 the weight of ingots increased by 290 kg and reached 6.9 tons. An eight-ton killed steel ingot is being introduced.

The personnel of the finishing shop has honorably met its socialist pledges. Thousands of ingots over and above the plan have been worked, the output has been increased at rush periods by 21.6 tons, thus 4500 tons of metal, a substantial quantity of fuel and electricity being saved. By lowering the cost of production the plant saved over 1 million rubles. On the production results of the 4th quarter of 1956 the plant was placed first and was awarded the title "Outstanding Rolling Plant of the Soviet Union."

Excellent work is performed by the steel-worker R. N. Nekhoroshev at the open-hearth furnace. He was more than once awarded the title "Outstanding Steel Worker of the Soviet Union."

The personnel of No. 3 open-hearth furnace led by the communist, Honorary Metallurgist, steel-worker Stepan Sergeevich Baev, attained a high production efficiency in the 4th quarter of 1956. This team produced 1024 tons of steel additional to the plan in the 4th quarter. In the All-Union competition of the workers of the Ministry of Ferrous Metallurgy plants, the team of Baev was awarded the title "Outstanding Team of Steelworkers of the Soviet Union."

The young steel workers in electro-steel plant, Honorary Metallurgist, Veniamin Stepanovich Orlov, was a winner in the plant's socialist competition on several occasions. His name has been entered into the Book of Honor of the plant.

Team No. 3 of the sheet-rolling plant, where C. Kartavykh works as senior roller operator and C. Yurchenko works as machine operator, fulfilled the annual plan two weeks ahead of time. The team had dealt with 3607 tons of metal in excess of the plan in 1957.

A high operating efficiency is shown by the machine operator of the rail mill Kachakov, the welding operator Krygin, by the senior roller operator Steptenko, by the machine-operator of 750 mill Galkina, and others.

On the left (from top downwards): R. N. Nekhoroshev, S. S. Baev, V. S. Orlov. On the right (from top downwards): M. M. Sheptenko, M. N. Kachakov, N. I. Yurchenko.

THE HOUSE OF TECHNOLOGY

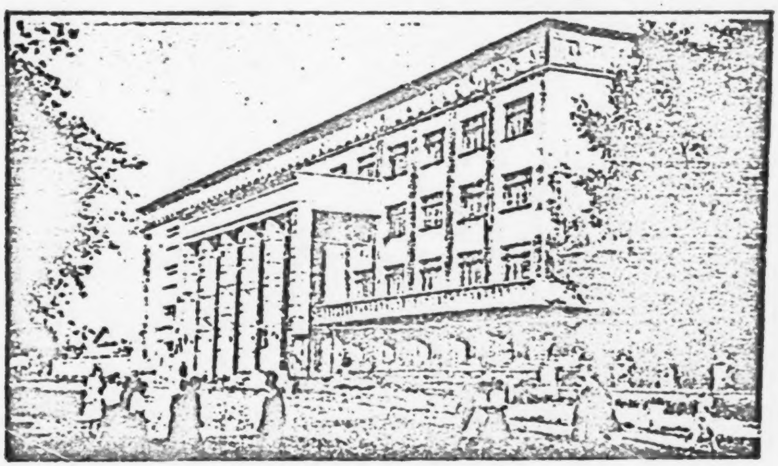
THE CENTER OF TECHNICAL INFORMATION

I. A. Suskov

Head of the Bureau of Technical Information

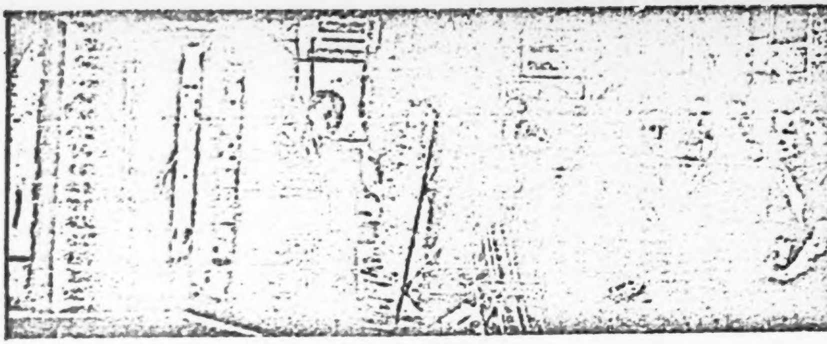
In 1933, on the initiative and with the close participation of the Combine's Technical Director, now the Vice-President of the USSR Academy of Science, Ivan Pavlovich Bardin, the Kuznetskstroi Museum — one of the first museums in the new industrial centers of the first Five-Year Plan — was created.

The new museum was extended with the development of the plant. In 1937 the museum was accommodated in the recently erected, spacious and full of light, Palace of Culture of Metallurgists. A new period in its work has begun. A separate room has been allocated to each plant of the Combine. The Museum has been enriched by the models of new machinery, by the collections of raw material samples, by the finished products of the plants and by the technical drawings and pictures of art illustrating the metallurgical industry.

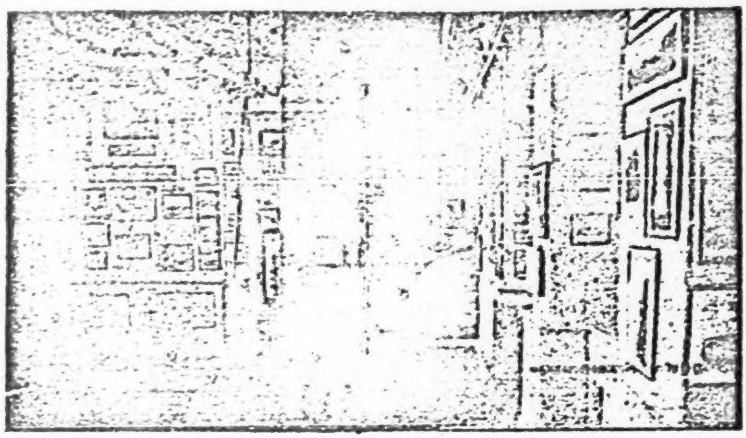


The Palace of Culture of KM Combine's Metallurgists. (TASS pictorial Review).

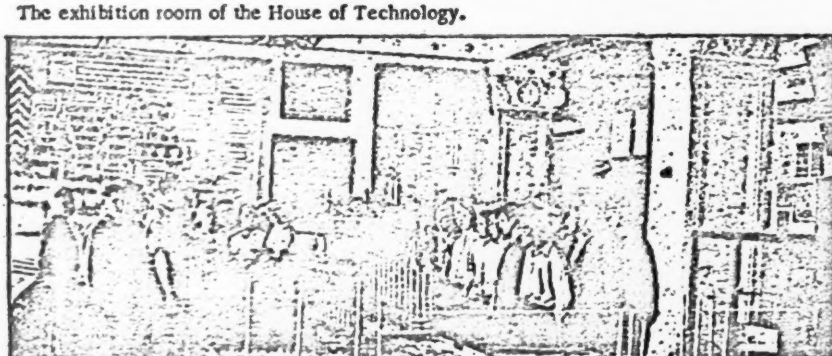
In the same year the first lectures were held in the museum. A Stakhanovite Study with a technical library was equipped. On the decision of the Eastern section of GUMP NKChM (State Administration of Metallurgical Industry of the People's Commissariat of Ferrous Metallurgy) the museum was renamed the "Educational Technical Museum."



A group of visitors looking at the model of a blast furnace.



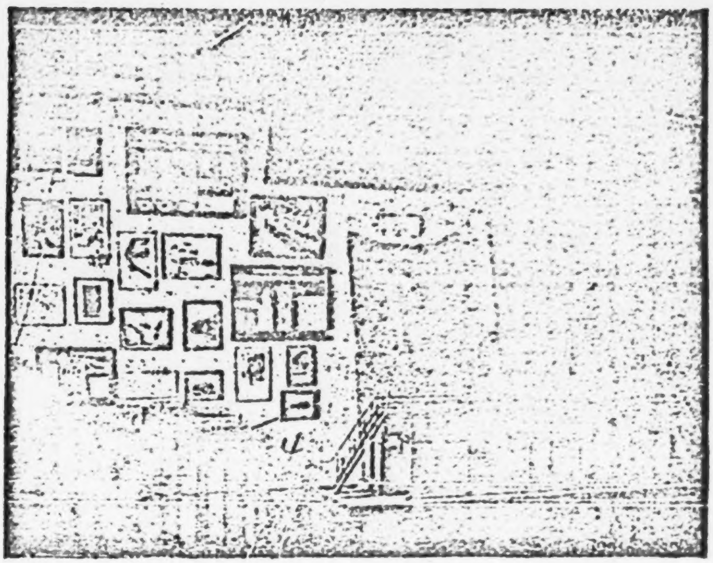
The exhibition room of the House of Technology.



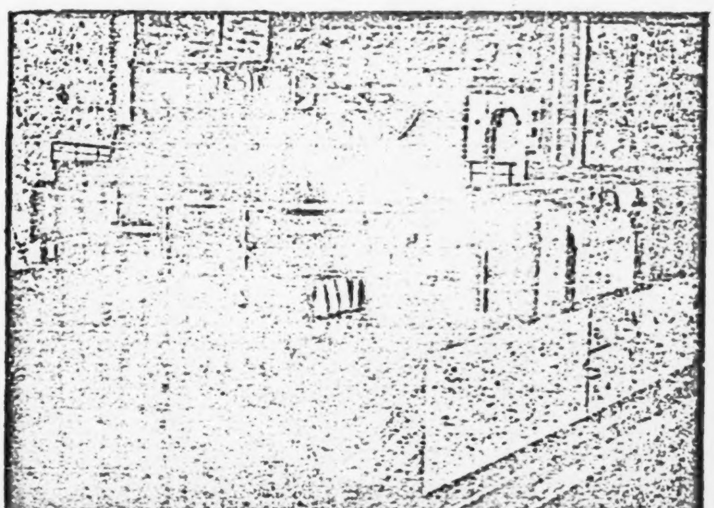
A group of students and future metallurgists, in one of the rooms of the House of Technology.

During the years of the Great Patriotic War the museum centered its activities in the plant shops. All efforts of technical information were directed towards the preparation of new personnel to replace those who joined the armed forces; with this aim in view numerous short-time courses and lectures were organized.

In 1943, by the decree of the People's Commissar of Ferrous Metallurgy, the Educational Technical Museum was reorganized as the "House of Technology," this being a distinction for its achievements in industrial technical propaganda.

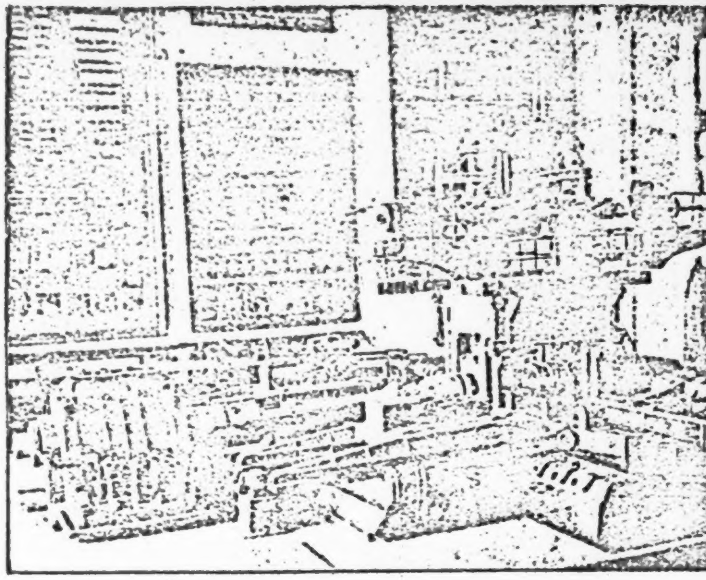


Steel production stand.

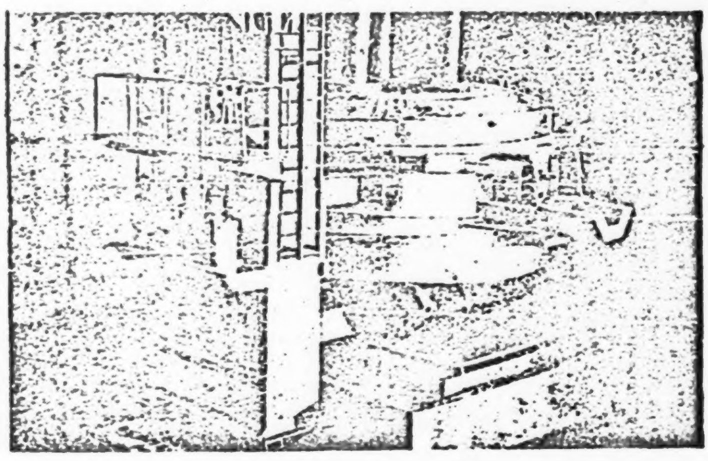


Open-hearth furnace model.

At the present time the Educational Technical Museum comprises ten departments: introductory, pre-historical, history of the Combine, raw materials, coke chemistry, blast furnace, open-hearth furnace, electric steelmaking, steel-working, rationalization and development of inventions. Over three thousand exhibits are shown in the departments and these are continually added to.



A blooming mill model.



An electric arc furnace model.

In each technical department, a stand is arranged where recent developments in the given branch of metallurgy are demonstrated. In the raw materials section, for instance, general interest is aroused by the new boring-unit BA-100 which are developed and constructed by the mine engineers of the Combine and by scientists of the West-Siberia Branch of the USSR Academy of Science. The adoption of this unit made it possible to increase the output efficiency of miners by 1.5 to 2 times and made their work much safer.

The museum is very popular among the working people of the town and of the Combine; in 1945 the museum had 5000 visitors, in 1950 – 38,700 visitors, and in 1956 the number of visitors rose to 43,700. In recent years the museum has been utilized as a laboratory of visual experimental appliances for the study of

metallurgical processes and equipment. The students of the Metallurgical Institute and Technical School, the students of the foremen school and of other educational establishments of the town work here.

The industrial-technical publicity plays an important part in the struggle for technical advancement. In accordance with a prearranged plan, the House of Technology is acquainting the metallurgists, by means of lectures and talks, with recent advances in science and technology and with the experience of home and foreign factories. Technical conferences, meetings and discussions on specific urgent problems are arranged. In the last 6 years, for instance, 63 conferences and meetings have taken place.

The problem of improvement of quality and durability of rollers was considered at one of the recent conferences. Seven papers were read and over 30 members took part in the discussion. The conference provoked a general endeavor on the part of the Combine to improve the technology of roller casting. The equipment for the casting of magnesium-treated rollers is already installed in the casting shop, and the diffusional deoxidation and the casting of medium-hard rollers with cast grooves has been introduced.

The House of Technology successfully employed various forms of technical information regarding the adoption of constant humidity blast, the change over to the high-pressure gas in the blast furnaces, application of the immersion thermocouple for the temperature measurements of liquid metal, improvements of technology of production of steel ShKh 15, and also with regard to the solution of other problems connected with further modernization of the metallurgical industry.

Lectures and talks on economic form an every-increasing part of the technical information service. The lecture of the Head of the Planning Department of the Combine, engineer N. G. Kropachev on "The Ways of Lowering the Pig-iron Production Cost," was a great success. By analyzing the separate items of cost of production, the lecturer showed that the Combine has all the prerequisites for the production of the most inexpensive pig iron in the country. The lectures "The Cost of Electro-steel and How to Lower it," "Organization of Work and Wages," and others, were of great value.

The House of Technology attaches great importance to the publishing of recent achievements and of valuable experience of home and foreign metallurgical plants. Lectures on the activities of interplant schools and technical missions, on All-Union meetings and foreign missions are systematically arranged. Over 70 engineers and workers gave such lectures in 1956 alone. For instance, the mechanicians of rolling plants, V. P. Nekhoroshkov, K. M. Tsarev, E. A. Zhuravkin and M. F. Zubakov, who visited other plants in the country, gave talks on the experience of these plants with regard to the utilization and the maintenance of the equipment. After his return from Sweden, Engineer V. I. Petrikeev gave several lectures on electrical installations and automation of metallurgical plants in that country.

After the discussion of the lecture given by the Head of No. 2 open-hearth furnace plant, M. B. Zilbershtein, on his mission, it was decided to adopt the introduction of steam into the under-checker of the open-hearth furnaces and the flushing of the upper rows of the checker with water.

As a result of the exchange of experience with other plants and the discussion of the reports of technical missions, the Combine adopted many valuable improvements. For instance, utilizing the technique of the plant "Azovstal," the Combine introduced the drying of the pig iron taphole by means of piercing the wet taphole with a ramrod 1.3-1.8 m long; from the Petrovsky Plant the movable instruments were introduced on 280 mill which made it possible to increase the output of steel by 2% and to improve the working conditions considerably.

The House of Technology attaches considerable importance to the publishing of the experience of the leading teams and workers of the Combine. During the last year 45 addresses by leading workers and 15 lectures by engineers were arranged. The senior foreman of the rolling plant, M. V. Slizen, jointly with the Laboratory of Work and Production Organization, has studied and published among all teams, the working practice of outstanding blooming plant operators I. A. Somov, M. A. Merkulov, and others. The senior foreman of the open-hearth plant No. 1, M. M. Privalov, frequently discussed with the steel workers and foremen his experience in maintenance and repair of the hearth floor. Many foremen have adopted his methods.

The House of Technology has a friendly and well qualified body of lecturers who, in the course of the past year only, have worked out 395 topics and delivered 630 lectures and talks. The leaders of plants and sections, the engineers of the Central Laboratory, and heads of shifts are invited to give lectures and talks.

One of the main tasks of the technical information service is the exchange of experience between the industrial concerns of the country. The House of Technology receives systematically the Bulletin of the Central Institute of Information of the Ministry of Ferrous Industry and informs the Institute about any new developments in the Combine. In the course of 13 years about 650 information items were sent to the Institute and in 1956 alone, 30 of them were published.

The booklets, leaflets and diagrams published by the Department of Technical Information jointly with the Mining Administration or with the Laboratory of Work and Production Organization, assist greatly in the publishing of the experience of leading teams, shifts and workers. The following booklets were published recently: "The Breaking of Ledge by Means of Deep Bore Mines," from the practice of the mine Tashtagol, and "The Advanced Methods of the Team of the 280 Mill." The booklet "The Advanced Methods of Gas Workers of the Blast Furnace Plant," and others, are in print.

The industrial and technical information assist the Kuznetsk metallurgists in familiarizing themselves with the recent scientific advances and modern techniques, in solving urgent problems of production, and in analyzing and improving the economic functioning of the concern.

AN IMPORTANT SOURCE OF THE OUTPUT INCREASE

D. S. Kachurin

Deputy Head of OTK (Department of Technical Control) of the Combine

In the 25 years of the Combine's operation the output of metal increased not only owing to the better exploitation of productive capacities but also owing to the improvement in the quality of the products and the decline of rejected material.

The data in Table 1 show the rate of decrease of the faulty rejected products and the increase of output of the first grade product.

TABLE 1

Year	Amount of grade-one product out of total production, %	Amount of grade-one product out of total production, %		
		Total	Out of total: In rolling	Out of total: In metal
1943	91.0	5.97	2.09	4.37
1946	95.6	2.51	0.754	2.16
1950	97.5	1.22	0.450	0.98
1955	98.3	0.904	0.280	0.687
1956	98.3	0.717	0.220	0.548

TABLE 2

Year	Rejection by consumers, tons
1944	2231.3
1946	1829.0
1950	1932.0
1955	411.0
1956	355.0

The improvement in the quality of metal and the decline in the quantity of rejects took place as a result of the improvement of production processes following the introduction of new technology and techniques, the automation of the operations, improvement of control methods and last but not least, as a result of a higher level of technical education among the workers, engineers and technicians.

The most improtant factor determining the high quality of the metal is the preservation of the constancy and continuity of technological processes.

One of the main tasks in the work of OTK is the timely forewarning of the prevention of breaks in the established processes.

The personnel of OTK pursues an active technological control. The controllers not only record the cases of deficiency but aim, above all, to prevent such deficiency.

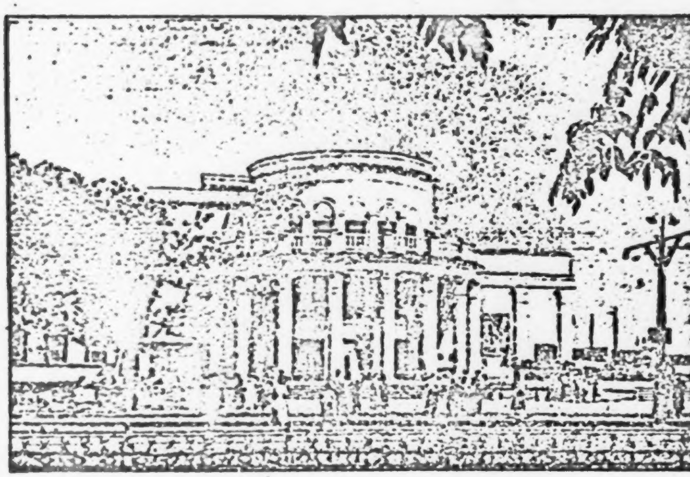
Our advanced foreman-controllers, the steel workers, comrades Kozlov, Ivanov, Malkov and Ilyasov, have accumulated considerable experience and have fully mastered the methods of inspection.

They give great assistance to the plant workers regarding the proper technological practice.

The rolling mill operators, controllers Gubarev, Serebrennikov, Shatunov, Gilev and others, keep thorough control of the processes in the rolling plant production and do not spare their efforts to reduce faulty production to a minimum.

The active control creates favorable conditions for the maintenance of a steady technology and secures the establishment of the optimum parameters of the processes.

The town of Stalinsk. The residential quarters for the metallurgists at School street. (TASS Pictorial Review).



The town of Stalinsk. The cinema "Kommunar." (TASS Pictorial Review).

The Department of Technical Control studies and analyses the sources of faulty production and the means of their elimination. In order to analyze the origin of faulty production the personnel of OTK make use primarily of reports on the observance of instructions and try to locate the sources of the faulty production and its prevention are the main objects of our work for the improvement of the quality of the product.

Extensive experimental development work to determine the best technological conditions for the processes is carried out in the Combine. The personnel of OTK participate jointly with the researchers and workers in this work.

The personnel of OTK takes all the necessary technical data which are then analyzed by the research workers of the Central Laboratory. Such investigation procedure makes it possible to encompass in a short time the whole complex of problems involving a number of experiments.

In many cases after studying the data collected, we ourselves complete the investigation, which makes it possible to improve the metal quality and reduce faulty products.

The OTK of the Combine keeps check on efficient utilization of the metal. For instance, when our workers visited the MPS railroad switch plant they noted that the components of the railroad switches at a certain length are machined (planed), and thus the minor surface defects on the ends of those components are eliminated The combine concluded an additional contract with this factory to supply it with a large quantity of ramp rails which were previously rejected. The Combine also supplies this factory with rails for rail wings and guide-rails. It was established that these components can be obtained from the rails which have been rejected on the ground of local defects. Thus it was possible to reduce the amount of rejects in the Combine and to reduce the metal losses in the form of trimming in the consumer factory.

One of the main factors indicating the quality of our production are the complaints by the consumer plants.

In recent time higher specifications with regard to the quality of metal have been introduced; hence additional tests not applied previously are nowapplied. Owing to these tests and the intensification of the inspection a steady decline in rejection by consumers was achieved; the data in Table 2 show this trend.

The Combine supplies a large quantity of structural steel for the construction of bridges, shipbuilding, car building etc. The established technology of the production and the control of all these products has secured, so far, the required quality of metal. Over a long period of time we have received no complaints from our clients.

When dealing with complaints, the Department of Technical Control first of all investigates the type of deficiency as given by the consumer and how it originated and then, on the results of these investigations takes appropriate steps for the technological improvements.

In most cases the complaints are dealt with and settled indirectly at the consumer factories. The detailed study of conditions of production of a given factory assists greatly towards the elimination of deficiencies.

Frequently we must apply much more strict tests than are specified by the corresponding standards. Thus a machine-construction factory rejected the chrome-nickel steel 12KhN3A material, complaining that after a specific heat treatment it did not possess the necessary properties. It was established that the reason was a slate-like fracture. A fracture test was introduced. Simultaneously steps were taken to eliminate the non-uniformity of metal and, in particular, the melting of this steel was carried out in an electric furnace, fairly small castings being made. As a result, the slate-like fracture of metal was eliminated.

The Central Laboratory of the Combine assists us greatly in the determination of the type of deficiency. By means of analytical investigation a rapid location and subsequent elimination of the origin of deficiencies is achieved.

In recounting our advances in the improvement of the quality of metal we should not forget considerable shortcomings, the main drawback being the persistent deterioration in the quality of the metal surface. The quality of the surface of worked billets is determined by the amount of surface defects, their depth, number and extent, and is expressed in "marks."

TABLE 3

Year	Mean mark of metal	Quantity of scale obtained on the autogenous treatment, t
1952	1.82	5 941
1953	1.55	7 621
1954	1.48	9 358
1955	1.46	11 944
1956	1.41	13 230

The finishing of billets is done by a combined method: by the method of fire finished and by the pneumatic hammers. The fire finishing predominates as it provides for a higher output compared with the pneumatic work. By applying, however, this method on a large scale we increase the metal losses in the form of scale considerably. It was established that the higher the defectiveness of the billets, i.e., the lower their "mark," the higher the loss of metal in the form of scale (Table 3). It can be partly related to the inadequate study of the effects

of the individual technological factors in the steelmaking and steelworking processes, on the surface quality of worked metal.

The investigations carried out in this connection do not yet allow final conclusions to be drawn and more than 85% of rejects still derive from the deficiencies of the surface. One would expect that with the deterioration in the surface quality the amount of rejects should on that account increase. A regular decrease of such rejects, however, takes place and in 1956 the amount of rejected material was reduced to 0.338%. The reduction in the rejected material on account of surface deficiencies is the result of the adoption of a number of organizational and technical steps in metal working plants (excluding finishing plant). New grooving, providing for a better treatment of surface defects, was introduced, the capacity of the fire finishing section was increased and the control of the defect rectification was improved.

The apparent reduction of the rejected material is favored by the fact that the rejects, due to surface defects appearing in the cutting operations of finished rolled material, are referred to the rolling plants. Hence the workers employed on the rectification of defects take special interests in a high quality metal working.

A large amount of rejected material is found in the production of some rolled steel sections, primarily of heavy girders rolled in the rail structural mill. As a result of the fact that all the sections in the rail structural mill are worked without the preliminary elimination of surface defects and in connection with the deterioration in the quality of metal surface the output of first grade sections constitutes only 90% and the rejects 2.3%.

Thus the main task of steel furnace workers and roll mill workers is the improvement of the quality of metal surface. This improvement constitutes the main means for the reduction of the rejected material.

THE MECHANIZATION OF LABOR-CONSUMING PROCESSES

L. M. Nikhinson

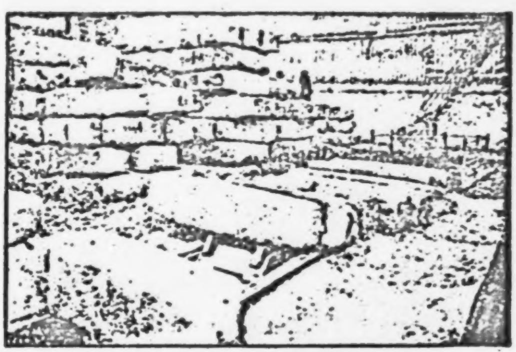
Head of the Mechanization Bureau

The Kuznetsk Metallurgical Combine was designed 30 years ago and therefore many modern design requirements have not been taken into account; hence in recent years of operation many an individual section of the Combine section where a great deal of manual labor was utilized, has to come under consideration.

It is very difficult to solve the problem of mechanization where it is necessary to adjust machinery already operating, and make use of existing structures and warehouses erected without taking into account possible future mechanization. In spite of this, the Kuznetsk metallurgists have done a great deal with regard to the mechanization of labor-consuming processes and auxiliary operations.

Mechanization has been introduced most effectively in the post-war years. Be it sufficient to say that in the years 1946 to 1956 no less than 982 mechanization projects were carried out, which made it possible to transfer 2283 workers to other full time work, 920 workers to part-time work, and lighten the work of more than 5000 workers.

One of the sources of increased metal production is the shortening of the idle periods of furnaces while under repair. While in 1955 the repairs to No. 1 blast furnace were carried out in 58 days, a year later owing to better organization of work and mechanization No. 2 blast furnace, requiring more work, was repaired in 53.5 days. It is easy to realize how much additional pig iron was obtained as a result of speeded-up repairs.



The mechanical tilter of ingots and castings. (Photo L. Vilner).

The idle periods of Martin furnaces in the Kuznetsk Combine on cold and hot maintenance are found to be the shortest, compared with other metallurgical plants in the country. In 1956 they represented 6.17% (average in the USSR according to the Ministry of Ferrous Metallurgy was 11.4%). Mechanization played an important part. While previously hundreds of workers were employed on the heavy work, such as the removal of slag from the slag chamber, the delivery of refractory and cement, the removal of the brick debris and dust, all this is now done by autoloaders, scrapers, containers, transporters and other mechanical equipment.

A great deal of preservance and ingenuity were shown by coke workers in order to find a method of changing the checkered brickwork of generators of the coke ovens without shutting them down for repairs. This is achieved by means of a special mechanical stacker, which has substantially increased the output of the coke ovens and lightened the work of the maintenance workers.

It should be mentioned, however, that the mechanization of oven repairs is far from complete. Let us point out that the initial work in ovens after shutting down is carried out at a high temperature, and this fact presents the plants and institutes with the task of developing and applying effective means of cooling of metallurgical furnaces when they are shut down for repairs.

Many interesting devices have been adopted in the rolling plants of the Combine, such as the handling lines with a pneumatic drive on the lifting tables of the finishing stand of the sheet rolling mill, the mechanical tilter of ingots and castings, and others. Many operations in the milling plants were previously performed manually and constituted bottlenecks in production (for instance the rail finishing shop in the rail-structural mill).

In the difficult conditions, without suspending the plant operation, the workers have mechanized the delivery of rails to the drilling-cutting machine (by means of dragging devices and roller conveyers), which improvement has freed 112 workers and increased the operating efficiency in this section by 50%. The mechanization introduced is especially important in view of the fact that the section of the rolled rails is becoming heavier and their weight now reaches 75 kg per 1 m length.

In the past years quite a lot has been done regarding the mechanization of our light-section mill of antiquated construction. The application of by-passing devices and roller passes on rolling bearings, the installation of lifting tables on the stands, the centralized lubrication of the equipment, the hydraulic removal of the scale from underneath the stands and roller conveyers and a number of other innovations made it possible to ease the work of the operators and increase the operating efficiency of the mills. All this is still inadequate, as the mills require complete modernization.

Town of Stalinsk. In the kindergarther of the Kutnetsk Met. Combine. E. A. Timoshenko has been educating the children of metallurgists for over 20 years. (Photo N. Nikotina).

Special attention is paid to the mechanization of loading-unloading operations. Shovels, wheelbarrows, and hand-barrows are replaced by cranes, draw knives, scraping unloading machines, scraper equipment, containers, and other special, manually controlled devices.

The introduction of this mechanization has necessitated the rebuilding of raw material and fuel stores in the railroad section, the construction of new cars or the conversion of existing ones in order to achieve the mechanization of loading and unloading operation during the conveyance of loose materials such as dolomite, open-hearth furnace slag, lime, coke fines and other materials. As a result of modernization carried out so far, the degree of mechanization of loading and unloading operations in the railroad section has reached 94%.

As regards mechanization, there are still many tasks ahead of us. Our researchers and inventors work hard to solve such important problems as mechanization of operations on the furnace channels of the blast furnaces, the clearing of steel outlets, the removal of checker bricks from open-hearth furnace regenerators, the coke oven door clearing, etc.

Many labor-consuming operations in the rolled steel finishing shop, for instance stamping, sorting and packing, are still not mechanized. The existing methods of removing defects on castings and billets by means of pneumatic chisels and emery grinders as well as the method of polishing of alloy steel billets by means of suspended abrasion machines are still far from perfect. The solution of these difficult problems is of interest not only to our Combine but also to other centers of ferrous metallurgy. Why then do the vast design organizations and construction bureau give the plants no assistance in the mechanization of labor-consuming operations?

Supplies, by the Ministry, of standard equipment indispensable for the complex mechanization of auxiliary operation on the Combine are completely inadequate. Thus the railroad section has to make locally the loading rail motor car for the mechanization of track works; to date the Combine still has no self-driving excavator, so that digging operations have to be done manually.

Our industry manufactures railroad track mowing machines, bucket loaders in small sizes and many other machines by means of which the auxiliary operations in the plants of the Combine could be mechanized.

The combine has every right to expect that in future it will receive the necessary assistance of the Ministry regarding the mechanization of labor-consuming operations.

THE CENTRAL LABORATORY

Engineer P. S. Plekhanov

Deputy Head of the Central Laboratory of the Combine

The Central Laboratory of the Combine performs two functions in the work of the Combine: it carries out the laboratory analysis of the raw materials, semi-finished and final products (the control laboratories) and conducts research and development work on the improvement of technological processes, on the improvement of the quality of goods produced and on the increase of the efficiency of the plant units (research and development laboratories).

The control laboratories are accommodated on the premises of the plant shops. They carry out 10-12 thousand physical and chemical determinations daily. The work of the laboratory ensures an accurate and rapid process control.

The research and development laboratories determine the technology of all the metallurgical production processes.

On the basis of the laboratory investigations, the technological instructions for day-to-day guidance in the work of the various plants of the Combine are prepared.

The best conditions for the concentration of Odrabash, Tashtagolsk and Sheregesh ores have been studied in the ore research laboratory. The Sheregesh ore of 44.8% iron content gave, on dry and wet separation, a concentrate of 57.4% iron content, the iron recovery from the ore being 88.7%. In 1956 over 130 thousand tons of ore was processed according to recommendation of the laboratory.

The magnetic analysis of Abakansk oxide ore of upper seams has shown that a concentrate of 50.97% iron content can be obtained from the ore of 43.1% initial iron content, the nonmagnetic fraction containing 30% iron. It would be necessary, in designing plant for these ores, to take into account the results of the investigations and to provide, apart from the magnetic separation, also for the flotation of ore.

As the result of Kazsk ore analysis, the Laboratory has recommended the technological improvements which were incorporated in the designs of the local ore dressing plant.

The Laboratory has developed the technology of the fluxed (sintered) agglomerate of a high mechanical strength and the basicity of 1.3. The technological conditions of Mundybash agglomerate factory have been improved; the operating efficiency of the machines has been increased by 2.5-3.0% and the ore savings amount to 0.5%.

The blast-furnace group of the laboratory has investigated the technology of smelting with the fluxed agglomerate and the operating conditions of the furnaces on the change-over from Magnitogorsk ore to Gorna Shoriya ore; the technology of furnace operation with an increased gas pressure has been investigated and developed.

The research on, and the adoption of steelmaking process furnaces with magnesitochromite refractory brick roofs should be mentioned among other work of the open-hearth furnace group of the laboratory. These roofs made it possible to raise the thermal capacity of the furnaces and to increase the furnace efficiency by 5-10%. The durability of the roofs has reached 762 runs on the small furnaces and up to 500 runs on the large ones.

The steel workers have mastered the open hearth furnace operation with pig iron of low manganese and phosphorus content. They succeeded in cutting down by 15-20 minutes the length of time of run in the large furnace and in decreasing the consumption of ferromanganese.

The technology of a partial or a complete deoxidation of effervescent (rimmed) steel in the ladle has been developed. The saving of ferromanganese of 2.6 kg/ton of steel has been achieved.

The work of the group has shown the disadvantages of the deoxidation of the rail steel in the ladle by means of the blast furnace ferrosilicon.

Following the recommendations of the group, the plant succeeded in decreasing the contamination of steel with nonmetallic impurities and effected economies in the use of deoxidizing agents.

The experience of the steel workers and foremen with regard to the technology of steel making has been studied. Steel is now produced with an even lower phosphorus and sulphur content than specified by government standards.

The laboratory has developed and introduced a 7-ton rectangular ingot to replace the 6-ton square one: the quality of the ingot being retained, the efficiency of the soaking pits and of the blooming mill 1200 have increased by 6-7%.

A study with the object of improving the technology of making and casting of ball bearing steel by reducing the nonmetallic impurities has been carried out. The adoption of the new technique resulted in the five-fold decline in rejected batches and in the lowering of the surface oxide defects marking from 2.8 to 1.6.

The technology of low carbon electrotechnical (dynamo) steel in the large open-hearth furnaces has been developed and adopted.

The electrometallurgist group has improved the technology of making and casting of transformer steel. The modification of the deoxidation method, the reheating of ingots, the soaking of castings and other measures have allowed a consumer plant to produce from Kuznetsk steel a new grade of electrosteel with a high magnetic permeability. Thus it was possible to manufacture small weight electric machines on account of the reduced weight of iron.

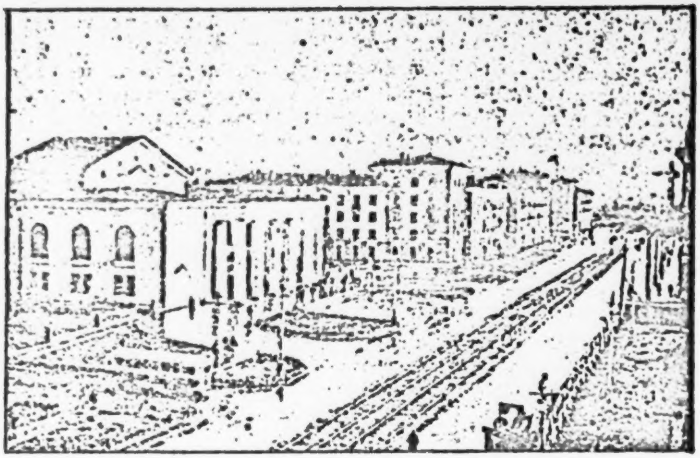
A successful study of the resulting improvement of the manufacturing of stainless and acid-resistant steel in the electric furnaces were carried out: the utilization of chromium wastes in the charge increased to 75%. The quality of hot rolled steel is very high.

The electrical heating of the deadhead of the 6 ton stainless steel ingots has been introduced. The simultaneous heating of 6 ingots has been made possible. The trimming waste of metal decreased from 16 to 10%.

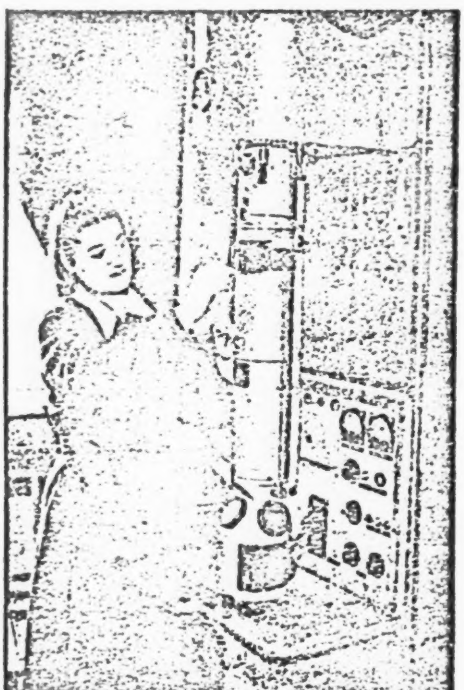
The thermotechnical group of the laboratory has developed and introduced the method of fast heating of ingots in the soaking pits. In this the rich experience of welding operators and foremen has been utilized. The heating system of ingots in the pits heated by coke oven gas has been developed. The length of ingot heating time has been cut down by 10-15% without any detrimental effects in the quality of metal. The preliminary work for the automatic control of the fuel feed has been carried out. On the basis of research, the methods of heating and working of 6-ton stainless, heat-resisting and acid-resisting steel have been established. The method of heating with an additional air feed to the burners in the continuous furnace of sheet mill and mill 500 have been introduced. The intensified heating resulted in 10-15% increase in furnace operating efficiency.

The modernization of the structural steel mill furnaces has been carried out according to the design prepared by the personnel of the thermotechnical group. This resulted in 25-30% increase in the efficiency of the furnaces.

The group concerned with the rolling of steel has developed the method of rolling of rectangular 7-ton ingots on the rolling mill 1200; the number of passes has been reduced from 15 to 11, and the operating efficiency of the mill has risen by 6-7%.



Stalinsk. The new residential housen on Ordzhonikidze street. (TASS Pictorial Review).



In the laboratory of the Kuznetsk Metallurgical Combine. Senior Engineer G. V. Kvyatkovskaya operating an electron microscope. (TASS Pictorial Review).

A great deal has been done on the improvement of quality of railroad rails.

The rolling of rails from the 7-ton ingots with a total 50-fold elongation has been introduced; the metal in such a rail is consolidated, the cast structure disrupted and the rail is strengthened.

The method of - -ling of the type R-65 rails has been succesfully developed; the microstructure of the rail is very good and the strength of rail foot very high; a fibrous peripheral structure was detected which indicates a satisfactory deformation of the metal on rolling.

The application of the most advantageous method of delayed cooling of rails in chambers has eliminated flake formation. The automatic method of hardening rail ends to the required hardness has been developed, the necessary profile of hardened layer has been determined and the transition zone has been established. Wear-resistance of the rail ends has increased five-fold; the rail rolling with a 45° turn of the profile of the rail with respect to the profile of the ingot has been adopted with the object of reducing the amount of cracks and seems in the rail base: the rail quality has been investigated from the point of view of microstructure and mechanical properties; the rail rejects due to the cracks in the base (up to 0.3 mm deep) have decreased from 1 to 0.15%, i.e., 6 to 7-fold.

The technology of railroad plates manufacture with oil quenching without tempering has been developed; the plates wear well and the cases of fracture have ceased. A new brand of steel has been suggested for

the stamping equipment in the rail clamping plant. The durability of the die increased 30-fold. The technology of two-layer sheet production from the 6-ton ingot has also been advances. The strength of the sheet welding complies with the TU specifications. The substitution of the acid-resisting sheet by a bimetallic one has saved the state up to 70% of expensive stainless steel.

Methods of a two-layer round billet working have been devised. The application of such material will increase the durability of machine components in corrosive media.

The technology of cast steel roller production has been developed, replacing forged steel. Thus it became possible to dispense with the rollers previously obtained from other factories.

The study of large-groove rollers in the high-grade mill have shown that the output per groove has increased two-fold.

The technology of magnesitochromite refractory brick production has been mastered.

The Central Laboratory is provided with the most modern equipment and facilities. The methods of labelled atoms, electronics etc. are extensively applied.

Radioactive isotopes are made use of in various studies, such as the deterioration of the hearth of the blast furnace; of the mixer walls and open-hearth furnace roofs; the nature of nonmetallic impurities in steel; the reaction velocity of steel deoxidation by iron alloys, the mixing of metal in the open-hearth furnace; the deterioration in the open-hearth furnace fettling; the segregation of elements in a steel ingot; the penetration of the filling charge, which is applied to reduce shrink holes, into the body of the ingot; and of the uniformity of mixing of components in the manufacture of refractories.

X-ray analysis is applied in the determination of stresses in 12.5 m rails. The elements in steel are determined by the radiometric method. The electron microscope and electronograph are extensively used in the study of steel structure and the study of the nature of individual components. The nature of nonmetallic impurities is studied by means of electrolytic deposition, and microchemical and petrographic analyses. The strength of welded joints and high-pressure vessels, the strength and continuity of castings, forged pieces and other sections is determined by means of gamma-rays.

The personnel of the laboratory is now working on the development of better methods of ore dressing for the blast furnaces and on the problem of the injection of coke oven gas into the tuyeres of the blast furnaces. Further work on production and deoxidation of steel is conducted. Industrial experiments on the application of floating metal devices for reducing shrink holes during casting are conducted. The application of radioisotopes is being extended to the study of metal deformation on rolling. New grades of steel in which expensive metals, molybdenum and nickel, are substituted by other elements, are developed. The work on the improvement of the heating method of ingots before rolling is being continued. New methods in the technology of steelmaking, rolling and thermal treatments of steel, with the object of improving its plastic properties at low temperatures, are studied.

THE UNTIRING INNOVATOR

R. Gurevich

When one enters the room under the hopper it takes some time before one is able to discern the people and the equipment of the control station. The room is permanently full of dust, coming from the loose material constituting the furnace charge, when it is charged into the furnace, and particularly from the agglomerate. The dust settles in thick layers on the equipment making normal work difficult.

The scale cars operated by the machinist leave the control station periodically travelling in one and the other direction. The technologists have just reported from the blast furnace that the furnace must now be charged according to a different scheme. The machinist, while straining his attention to check the right order and the amount of different material in the charge, performs, simultaneously, many complex operations controlling the scale cars. Suffice it to say that in the course of one hour he had to deliver to the charging mechanism of the furnace up to 90 batches.

Such work puts a heavy strain on the operator. Towards the end of the shift the machinists get tired, do not work fast enough and efficiently; sometimes errors occur.

The electrician of the blast furnace plant, Vasily Grigoryevich Guryanov, was relentlessly pursued by the problem of how to ease the enormous strain on the machinist and how to ensure steady charging of the furnace.

The electrician spent all his free time on the charging yard. Again and again he watched how the machinist, while engaging the gear wheel of the loading chamber with the transmission drive gear, was simultaneously opening the gates and how the ore was poured into the container of the scale-car and was at the same time weighed.

"Every move of an automatic machine has to be calculated very carefully" Guryanov thought. "The functions of the machinists can be performed by an accurate, sensitive automatic device."

For several years he tried to devise electrical equipment which would synchronize the complex and accurate operations of separate mechanisms.

First trials were unsucessful; the charging was irregular, the automatic control broke down at one point or another. Guryanov , together with A. F. Igolnikov, V. I. Toichenov, B. S. Berezkin and other Combine designers had worked out several plans. But the automatic weighing was still unsuccessful.

The experienced electrician, however, by painstakingly studying the reasons for failure has finally found a reliable arrangement: a hinge and cog screen on the cylinder of the charge chamber. The agglomerate, ore and limestone began to be charged regularly at prearranged intervals into the furnace.

. . . . Several years have passed. Now the system of furnace charging is fully automatic. The loading of coke and of ore charge, the coke sorting and scale-car operations are done automatically. A single impulse resulting from the change in the furnace stock-line puts into operation in a predetermined sequence about thirty separate charging mechanisms. The automatic control equipment installed in the control station replaced the machinist operating the scale-car.

The main apparatus of the charge loading station equipment is the reversible magnetic controller. The mechanisms of the electric contactor apparatus load and weigh automatically the materials constituting the furnace charge. They also ensure a regular and predetermined order of loading and weighing of each component and the required cycle of operations in charging the batches and components.

A sound and light signal system is installed in the control station and in the gas booth and is provided for the case when the scale-car is not loaded in time for the due run.

The mechanical devices have relieved the man from heavy manual labor and have taken over his work. Previously, each scale-car was operated by two men; the machinist and his assistant. Twenty-four men were employed on these duties on four furnaces. Now only one electrician looks after the proper functioning of the equipment and the change in the charging scheme (according to the requirements of the technologist) and he can cope with several furnaces simultaneously.

The automatic control system of the scale-car operation devised by V. G.Guryanov has been adopted for three blast furnaces of the Combine. The use of standard connections and relays and the application of the simplest possible schemes with insignificant disadvantages, made possible not only a rapid setting-up of the automatic assembly (in 20-30 days) but also its mastering by a wide circle of operators.

—"How are the scale-car machinists now employed," — we asked Guryanov.

—"The machinists now attend special courses arranged in the plant. You see, to operate the automatic control equipment is much more complex work than to operate the scale-car. The electrician-adjuster is a new trade requiring new knowledge and thorough training."

While extending the serviceable life of machinery and relieving workers from heavy labor, automation promotes the furthering of the technical knowledge of the people and their general cultural advancement.

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The inclusion of the scale-cars in the general automation of the charging system has created conditions for increased output by the Kuznetsk blast furnaces.

But the tireless innovator has discovered yet another unsolved problem. The blast furnace air heaters were equipped with obsolete fittings, and valves had no mechanical gears and were operated manually. The operation was time- and labor-consuming. The inadequate capacity of the equipment resulted in pressure drop and loss of blast to the furnaces.

The air heaters contain up to 17,000 cu. m of gas and air, — and therefore it is not difficult to imagine what emotions and mental and physical strain were experienced by the gas operator when reversing the air heater from "heating" to "blast," i.e., from gas to air. The smallest calculation error or an inaccurate move and everything could explode.

In addition, in different plants and even on different blast furnaces of the same plant every gas operator, using his own knowledge, experience and observations, conducted heating and blasting processes in his own way. This led to the unsteadiness of the air heating operation.

Guryanov decided to introduce automation of the air heaters.

Together with engineer, V. Burtsev, Guryanov began to work out plans for automation of the air heaters. At the same time engineers L. Ya. Matusevich, B. N. Zherebin, V. I. Petrikev, foreman P. V. Oslin, electrician V. I. Borovskikh and others have carried out substantial works on the modernization of the air heater equipment.

The obsolete fittings have been replaced. The air heater building itself was made larger and higher. The old burners were replaced by new, more powerful burners, not standard ones but specially made on the Combine.

Guryanov and Burtsev had to solve a difficult problem: it was necessary to delimit very accurately, including all the minute details, all the operations involving the temperature and blast conditions, to determine the impulses initiating and terminating the processes and to establish the sequence of the functions of automatic equipment.

The more complex the scheme became the more the innovators persevered in their task. They aimed at a system which would combine in a single unit the control of all the processes. Separate units had to be modified, technical innovations were introduced. And finally the intense creative efforts of Kuznetsk workers were crowned with success.

A main link — the time motor relay — was found. The relay gives a command-impulse to a special calculating machine to which the conditions of the processes are fed. These can be fed for different periods of time: from one day to one year. The valve reversing (i.e., the change from "heating" to "blast" and from "blast" to "heating") takes place according to the impulse of time relay by means of a special calculating machine — the program commutator. The commutator assists in the establishment of any sequence in the selection of conditions.

An additional problem was solved: the commutator, after completing a given program reverses automatically the air heater from "blast" to "heating" and vice versa.

The hot blast valve is of a special construction with a welded disc and rings, the body being provided with a water jacket which prevent overheating.

Among the innovations is also the establishment of special automation control stations and mimic bus panel clearly indicating the conditions of each air heater. If, from any cause, the valve change did not take place, the blower ceased working, or gas pressure dropped, sound signal warnings would be given.

Special equipment analyzes the products of combustion. In conformity with this analysis the most economical system of operation of air heaters is set up.

The efficiency of air heaters increased by 10% owing to automation. In addition the strict conditions of operation make large gas economies possible. All this will contribute to a saving of several million rubles in a year. The length of time for reversing has been shortened approximately five-fold. While the valve reversing previously took 25 to 30 minutes, now it takes 5 to 6 minutes. The automatic blocking has unified the air heater block operation into one system with other mechanisms.

At present the automation is introduced in air heaters of two blast furnaces. In the near future the remaining blast furnaces will be included in the automatic system.

The Minister of Ferrous Metallurgy, while recording the valuable creative initiative of Kuznetsk Combine innovators in the blast furnace industry, has thanked a large group of Kuznetsk citizens and awarded them the badge "Excellent Participants in Socialist Competition." Among the first workers mentioned was the work instructor, senior electrician of the blast furnace plant, the untiring innovator Vasily Grigoryevich Guryanov.

30 YEARS OF SCIENTIFIC AND TECHNICAL LIBRARY WORK

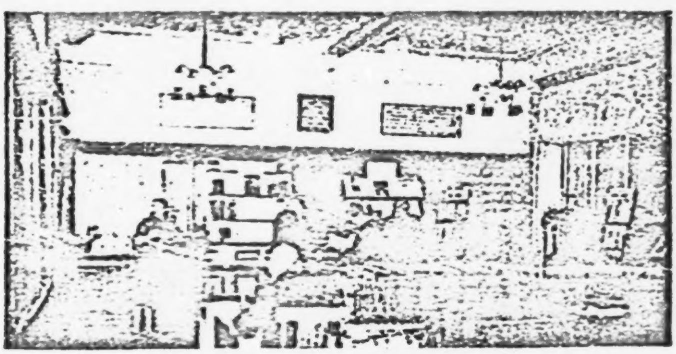
N. A. Labeeva

Deputy Director of the Scientific and Technical Library

The library of the Kuznetsk Metallurgical Combine was organized in the town of Tomsk at the time when the Combine was being designed. On January 10, 1927 the first book was entered into the catalogue. The readers at that time were the engineers-designers of Telbessbureau who were working on the design of the future metallurgical giant. The library, together with the archive of drawings, was accommodated in one small room and its complete stock took up only a few book cases. In January of 1928 the first librarian was appointed and he took over 843 books.

In 1930 the library moved to the erection site of the Combine where it served new readers – the builders of the plant. The plants and shops were erected one after the other, and in the library new readers were appearing: power engineers, mechanical engineers, metallurgists. The library was accommodated in one room, its equipment consisting of crude, wooden, dark-red painted bookshelves. In the evening the Comsomol meetings were arranged in the same room. The annual budget for the library was 10,000 rubles.

In the Autumn of 1933 the library came under the control of the technical Director, now Vice-President of the Academy of Sciences, USSR, I. P. Bardin. At the end of every month the chief Librarian submitted to the technical director a report and discussed plans for the following month.



Reading room of the Scientific and Technical Library of Kuznetsk Metallurgical Combine.

The technical efforts of the Combine were aimed, at that time at the solution of two problems: the mastering of the blast furnace operation with ores containing zinc and the elimination of crust from the blast furnace. As the library had no facilities for literature search, it asked the assistance of the Leningrad Technical and Scientific Library of GIPROMEZ and not receiving the required information from them, wrote to the library of the Iron and Steel Scientific Research Institute in London. The Institute supplied literature on the operation of furnaces with zinc-containing ores. This valuable literature was distributed among the workers of the Combine and sent to Academician Pavlov, to the Leningrad Institute of Metals, and other organizations.

Thus the library succeeded in collecting considerable literature which contributed to the solution of both problems. In this way the custom was established of using the services of the bibliography information section when new plants were started and new machinery introduced, or new technological processes were developed.

In August of 1934 the library moved to the building of the Central Laboratory where excellently equipped accommodation was given to the library: a large pleasant reading room and a book store-room with metal shelves. Lectures on technical subjects were held in the reading room, and once every ten days meetings of NITO metallurgists with lectures on advances in technology.

In the early years of the library's existance th. only readers were the engineers and technicians. By 1936 the library had 832 readers. It then became necessary to attract workers to the library and to assist them in acquiring new knowledge, without which the work in the new conditions was impossible.

On the suggestion of N. K. Krupska, it was decided to stock the library with popular technical literature and bring it within reach of the workers.

The Technical and the Trade Union Libraries have organized a mobile library. It was, however, not successful.

In the middle of 1938 the Library set up its first branch in the blast furnace plant. The books for the branch were thoroughly collected according to subjects suggested by the head of the plant, A. F. Borisov. The branch library had political and technical books, journals, translations from the foreign literature on the iron industry and other information material. An exhibition of literature on recent advances in blast furnace operation in the blast furnace maintenance generally and the maintenance of the blast furnace taphole, was arranged on the opening of the branch library.

Very soon branch libraries were opened in other three plants and on the 1st of January, 1939, the library had 4593 readers, half of them being the workers. Thus books were placed within their reach.

For its well-organized information and bibliography services the People's Commissar of Ferrous Industry renamed the library the Scientific and Technical Library on January 2, 1940. The book stock then reached 93,265 volumes and the number of readers reached the figure of 5,608. In the course of one year 133,354 books were on loan, 201 literature-search inquiries were answered and numerous translations from foreign literature were made.

During the years of the Great Patriotic War the Library served the workers of the plants and of the scientific research institutes and planning organizations evacuated from other parts of the country to Stalinsk. Apart from the Combine, 38 other organizations were served by the Library. The number of readers rose to over 7,500.

The personnel of the Scientific and Technical Library extended the activities of the Library to the evacuees' hospital where a Library was set up, with books collected among the Combine's personnel. Reading aloud was organized twice a week in the wards. The hospital management has mentioned on several occasions in its circulars the remarkable cultural and educational work of the Library personnel and expressed warm appreciation of the cultural services to the wounded.

After the end of the war and re-evacuation of many organizations the management of the Combine extended the Library accommodation by expanding it to four times its original size.

The stock of the Library was increased year by year. While in 1928 the Library had 843 books,on January 1, 1957, the stock had risen to 734,000 books and journals.

Only five years ago 10,205 readers were served by the Library; now their number has doubled. In 1956 635,118 books were in circulation – 200,000 more than in 1950.

The Library is now supervised by the Chief Engineer of the Combine. There is a Library Council presided over by the Deputy Chief Engineer. The Head of the Technical Department of the Combine has been appointed a permanent consultant on all problems met by the Library.

The basis of the Library work is the resolution of the XX Congress of the Communist Party of the USSR, making obligatory the mastering and application of new technology and technique and the furthering of technical education of personnel. For extensive publicity regarding the literature relating to the advancement of science and technology, and modern industrial practice the Library employs various means: such as exhibitions of new books and journals, and exhibitions on topical subjects for the Combine. The libraries at the

individual plants are closely connected with the plant Technical Departments. During the past year 120 industrial exhibitions were arranged on such themes as: "The carbon-containing refractory materials for a modern blast furnace," "The effects of steam on the blast furnace process," "The high temperature blast," "The application of oxygen in the scavenging of pig iron in the ladle," "The increase of the durability of open-hearth furnaces" and others. During the symposium on the quality improvement and the rationalization of rail grooving, an exhibition on the theme: "Production and use of rails" was arranged.

Literature surveys are one of the most effective methods of technical publicity. These surveys are either of an informative character (e.g., "New literature on open-hearth steelmaking for the first quarter," "The new literature on electrical engineering for the first half-year of 1956"), or they give a concise account on a particular subject ("The automation of furnace processes," "Control of the thermal processes of the open-hearth furnace," "The manufacture of chrome-magnesite refractories"). These surveys are prepared by the engineers.

The library frequently arranges readers' conferences. Recently a conference on the book by M. Ya. Ostroukhov "The boosting of the blast furnace smelting" took place in the blast-furnace plant. The blast furnace workers have actively discussed the book and the minutes of the discussion have been sent to the Metallurgy Press. The conference of the readers of the journal "Metallurgist" was attended by 90 people. In the course of the year 10 various conferences were arranged.

The Library publishes a monthly bulletin for the engineers and technicians and a bi-monthly wall newspaper for the workers.

Our library aims at keeping pace with modern life keeping the readers informed about all that is new in the literature, and assists them in every-day work.

THE KUZNETSK DEPARTMENT OF THE NTO ChM (SOCIETY OF SCIENCE AND TECHNOLOGY OF FERROUS METALLURGY)

O. N. Masyuzhenko

Deputy Chairman of the Kuznetsk Inter-regional Management of NTO ChM

Six years ago, in the Kuznetsk Metallurgical Combine a section of VNITOM was established, which was subsequently reorganized into Kuznetsk Inter-regional Management of Scientific and Technological Society of Ferrous Industry, and which at present comprises all the metallurgical plants of Kemerovsk and Novosibirsk regions. The Society has 2600 members and 13 sections, including a mining section, blast-furnace section, coke oven section, steelmaking (open-hearth furnace industry) section steel-finishing (rolling) section, electric steelmaking section and others.

In the comparatively short period of its activities the Kuznetsk Management of NTO ChM carried out important work regarding many a problem of the metallurgical industry. Special attention is paid to the scientific and technical advancement of the members of the Society. With this aim in view the Society organized, in 1956 alone, 450 lectures, talks and seminars, 74 scientific and technical meetings, discussions and conferences, including two conferences of importance for the entire Union: on the improvement of quality and the increase of durability of mill rollers and on the improvement of quality and rationalization of grooving of railroad rails.

The Kuznetsk Management of NTO ChM has published the first Collection of the Transactions of the Society and plans to continue the publishing of the Transactions 3 to 4 times annually.

The foreign-language circles are working regularly. The program of activities provides for assistance to the Combine in the application of valuable innovations and modernizations.

The membership of the Society increases continually; it has doubled from 1955 to 1956.

The main shortcoming in the work of the Society is that its activities are frequently somewhat detached from the most essential and urgent problems requiring solution in the industry, whereas all industrial advancements should be publicized, first of all, by the Society.

The Society has not yet become a genuine mass organization. This shortcoming can be eliminated by systematic work on serious scientific and technical questions, and on the solution of practical problems and when participation in the activities of the Society will not be regarded as an obligatory burden.

We have important tasks in front of us. The main work of the Society is carried out in the branch sections, hence they have to solve the most urgent problems in the corresponding branches of industry.

The blast-furnace section should tackle in real earnest the problems of the automation of the blast furnace process, the problem of blowing the coke-oven gas into the blast furnace process and, first of all, the question of the economic feasibility of such steps.

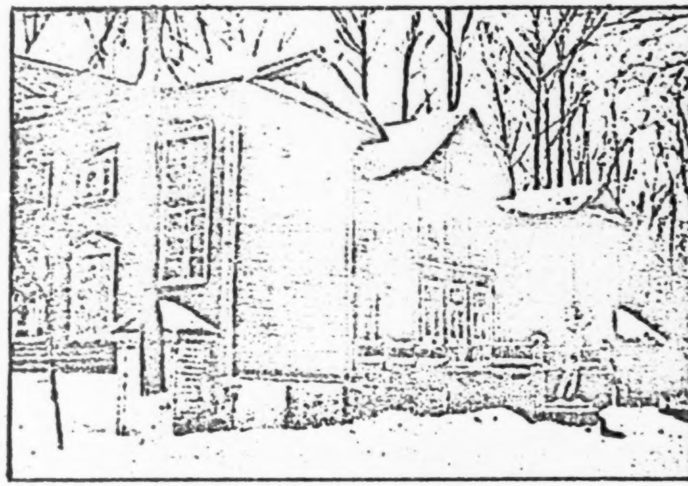
The steelmaking section should develop the technology of the production of new grade steels, solve the problems connected with the quality improvement of the blast furnace metal, the application of oxygen for the intensification of the melting processes, and others.

The steel-rolling section has to tackle the problems of the new profiles, hardening the grooves by means of hard alloys, autogenous continuous purification of the metal, the automation of rolling operations, the mechanization of finishing and stamping operations, etc.

The mechanical engineers have to find means of strengthening the component parts of mechanical and mining equipment. Other sections are also faced with important problems.

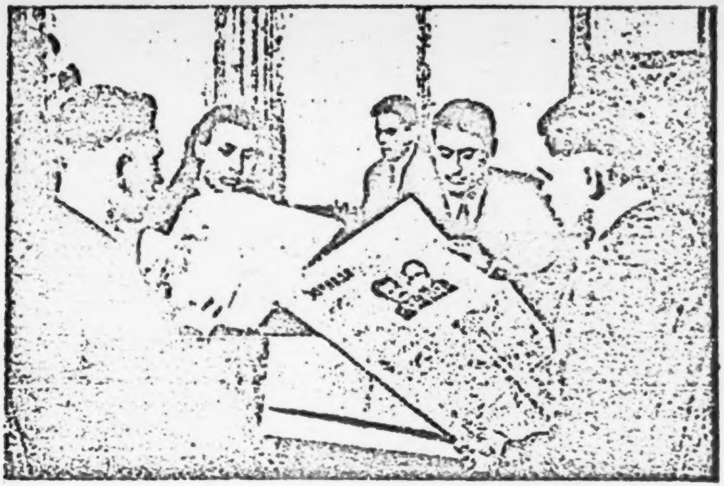
The sections and the Society as a whole will be able to solve the urgent problems and to assist the Combine to increase the output year by year, only by discussions in a free and business-like atmosphere.

"TOPOLNIKI"



On the bank of the swift river Toma in the shadow of old poplars are the pleasantly situated two-story buildings "Topolniki" (Topola – poplar) – the night sanatorium of the Kuznetsk Combine. A bus bringing the workers who have just finished their shift in the plant stops in front of the entrance. Next morning the same bus takes them back to furnaces, stands and machines.

The sanatorium takes the workers who have been recommended for medical treatment. They are met here by the senior physician, Klavdiya Danilovna Kulyasova. She thoroughly examines the convalescents so that they leave the sanatorium strong and healthy after 24 days' rest.



You can have a comfortable rest in the sanatorium, read a newspaper or a magazine or have a game of chess. And if you so wish, you can see a motion picture .... .

Photo N. Nikotina

MASTER OF BLAST-FURNACE INDUSTRY

Aleksandr Bek

The eminent Russian blast-furnace specialist Mikhail Konstantinovich Kurako, was born in 1872, of a noble family in Mogilevsk province. At the age of 15 he could no longer endure the despotic system of upbringing, ran away from his family home, and came to Bryansk metallurgical plant in Ekaterinoslav.

He started work as a cramp-iron boy, went through all the blast-furnace occupations, and became a furnace attendant when only 18.

The mastering of the blast-furnace art became his life. The passion for this work remained with him for life. He wandered over the plants of Krivorozhya and Donbass in a vain search for a master worthy of admiration.

New plants were being erected in the South. Rumors of American construction of two wonderful new furnaces in Mariupol were heard among the blast-furnace workers. Kurako went there. The Mariupol furnaces were the largest in Russia at that time and, which was more important, were equipped with many mechanical devices. The tuyeres, the guard plates, charging systems and the air heaters— all were of the latest construction.

Having seen the American blast-furnace operating, Kurako at once appreciated the furnace construction which practically eliminated the danger of hearth breakdown. This was powerful means of mastering the furnace— of gaining control over it.

Perceiving the ideas of the designer, Kurako was eager to study the equipment— to handle it himself— but all mechanical equipment was operated by Americans and the Russians were not allowed to do this work.

However, Kurako succeeded in taking part in the furnace operation. He became a furnace foreman.

Kurako's old friends began to join him in Mariupol. They were desperate blast-furnace workers, men of vigorous health and full of strength. Kurako recruited them from every plant where he had been working.

After a year the Americans left Mariupol and the furnaces were taken over by the French. Very soon they blocked one furnace. Kurako corrected the fault, and from this time the fame of this Russian blast-furnace man as a furnace master became firmly established. He was frequently invited to "revive" blocked furnaces.

In the autumn of 1902, at the peak of industrial depression, Kurako received visitors from Kramatorka plant belonging to the German firm, Borsieg. One furnace of the Kramatorka plant was blocked, the other operated irregularly for a considerable time and produced sulfur-containing, useless metal. Three million poods (1pood = 36 lbs) of rejected pig iron, unacceptable by consumers, was piled in the plant yard. Kurako had both the furnaces functioning in two weeks.

The management offered him the position of head of the blast-furnace plant. Their conversation took place in the office of the concern manager, a fat, Russianized German. Kurako accepted on condition that both furnaces would be mechanized.

"What do you need that for?" the German asked good humoredly, "the Russian workshoe is the most economical mechanization."

Kurako turned pale,

"When it is used for face slapping...."

The German did not grasp the meaning and asked:

"What did you say?"

Kurako rose from his chair, banged his fist on the table and repeated clearly and deliberately:

"When the bast shoe is used for face slapping."

The manager began to appease the man and accepted his conditions. They agreed that the profits made by Kurako would be used for the modernization of the furnaces.

Then Kurako's former men came from Mariupol to Kramatorka. Literally within a few days miraculous changes took place in the plant. The furnace began to produce first-class pig iron at $1\frac{1}{4}$ times the rate of the best earlier runs. Kurako had not yet made any modifications; he only put his men to work and settled himself in the blast-furnace cabin, spending days and nights at the plant.

In the first year of Kurako's employment the plant showed a profit of half a million rubles. He was then allowed to build a blast furnace according to his own design. At last his dreams would come true! For the first time he was given the fascinating work of a designer.

Kurako's lodging was something between a testing workshop, a laboratory, and a design office. The tables were full of drawings, drawing instruments, and rulers. On the floor were heaps of ore, flux and coke. The iron models were the most remarkable in this chaotic setup. There were various scale models of the mechanical equipment for charging of the furnace. Kurako was preparing charge equipment of his own design.

For days on end he poured materials from the heaps on the floor into the special troughs of this model, and watched how the pieces of ore, limestone and coke fell into the trough. He varied the height of fall or the inclination angle of the troughs. Sometimes he played with the mechanisms, improving the system of containers, which opened in turn. Then again he would drop stones and would watch their fall.

After prolonged tests, the charging equipment of Kurako's design was installed on one of the blast furnaces. The results were excellent. Kurako was congratulated with his success. But after three weeks, signs of irregular side-running appeared in the furnace.

Kurako spared no efforts in investigating every detail. Everything seemed to be in perfect order: the charge was delivered regularly and had right composition, gas operators were in control of regulators and the furnace was receiving the required blast. The fault must be sought in the charging equipment.

Searching for a fault in construction, Kurako measured and checked all the components of the mechanism against the drawings. A hardly noticeable inaccuracy was detected in the construction of the troughs, but after this was rectified the furnace continued to work irregularly. The furnace fire began to go out, causing despair among Kurako's furnace attendants. Kurako, however, still hoping to find the cause of this trouble, climbed the stack. He leaned over the open mouth of the furnace and looked long and intensely into the dark hole. Suddenly, a joyous shout was heart from the top of the furnace: "The ring, the ring."

There was no constructional fault in the charging mechanism. The source of the trouble was the iron guard ring. It was buckled by the heat and was protruding in one place near the center of the furnace. This was causing irregular drop and faulty distribution of the charge.

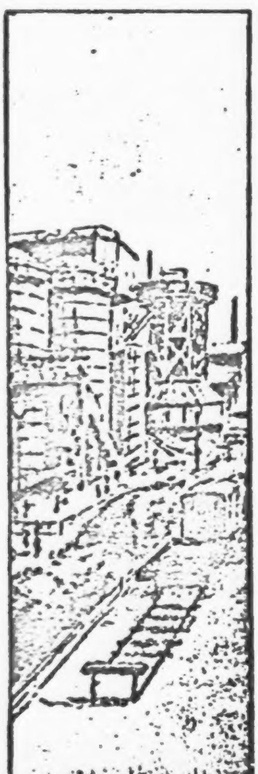
It was now necessary to enter the unextinguished furnace and to remove the troublesome ring.

Kurako, the mechanic Eremenko, and two fitters undertook this dangerous task. Kurako gave orders to stop charging the furnace and let it burn slowly. He waited until the furnace stock-line had fallen a few meters. Then the blast was turned off. On the top of material remaining in the furnace a layer of wetted ore and coke fines were poured, thus sealing off the rising gases. It was necessary, however, to keep slow burning in the furnace, which necessitated the supply of air. Thus the flue gases in the stack were unavoidable, and penetrated the layer of dust in small streams. In this poisonous atmosphere Kurako and his friends accomplished their bold experiment.

Kurako's plan was very simple; cut the clamps holding the ring and throw it down the furnace where it would melt.

Wooden ladders were lowered into the furnace. It was decided to work in pairs. First pair — Kurako and Eremenko, second pair — two fitters. Each of the daredevils was tied to a rope held at the top of the furnace so that in case of fainting the man could be pulled up.

Drawing by G. Zhegina.



Unprotected, Kurako and his friends descended into the dark abyss, expecting any moment to be consumed by fire should the flame burst through. Each pair, when lowered, cut the rivets for five minutes at a time. Then the other pair took over. The appalling work dragged on endlessly. After five minutes inside the furnace a man needed a long rest in fresh air to recover.

After twenty-four hours' work the ring was still in its place. Meanwhile in the furnace the slow combustion continued leaving the top material suspended over half-empty space; the fall down of the furnace charge could be expected any minute, and it came.

The ring, leaning on one side was held by the last bolt. The two fitters were hammering at it. Suddenly a roar, like an explosion, forced the workers standing near the hearth to jump back. Red-hot pieces of coke together with clouds of black dust burst out of the furnace. Eremenko, who was standing at the mouth of the furnace, was flung away against the iron framework and lost consciousness for a moment, only to come to experiencing intense pain: his clothes had caught fire from the glowing coke. He managed somehow to put it out. Silence fell, but still nothing could be seen in the clouds of black dust. He heard Kurako's voice calling the fitters. They answered. By a lucky coincidence at the moment of the furnace charge fall they were already ascending the ladder and the air blast flung them out of the furnace. Both escaped with shock and bruises. Shouting and groping their way they soon found each other, and Kurako embraced the fitters.

"If you had remained in there I would have jumped in myself" — were the first words of Kurako.

Kurako's understanding was successful. A blast of tremendous force, caused by the crumbling material, tore off the ring and it fell down the furnace. The blast furnace was saved.

Kurako enthusiastically joined the revolution of 1905. He, as the head of the blast furnace plant, became Kramatorka's favorite public speaker. His blast furnace army became a fighting squad under his command.

Kurako gave support to all those who called for an armed rising.

The management fled the factory. The Revolutionary Workers' Committee assumed authority in Kramatorka. The blast-furnace workers elected Kurako to the Revolutionary Committee.

At night, after conferences, meetings on military exercises he could not sleep. He would get up from his oilskin sofa, sit at his drawing desk and draw sketches of a blast-furnace plant which he would build after the victorious revolution. At dawn he was pacing the factory yards and measuring with a measuring tape the sites where new powerful mechanical equipment would stand. He dreamed of and visualized a new, powerful plant on the site of Kramatorka.

In 1906 Kurako was arrested by the police and deported to Vologda province.

After a few years Kurako is seen again in the South — in charge of the blast furnace of Yuzovka. The plant was then nicknamed "Kurako Academy."

In the blast-furnace cabin one could always see his drawings, journals and models of furnace equipment, all over the place. Here problems were discussed; student-probationers flocked to Kurako. The cabin became famous far and wide. Students from every institute were anxious to get practical experience under Kurako.

Kurako had a very large collection of drawings, probably unique in Russia. There were sketches of old, obsolete furnaces, of operating furnaces, of other factories and sketches of most diverse French, German, Belgian and American furnaces. Sometimes very small details, which however were considered of importance by Kurako, were underlined. This collection and Kurako's personal advice were always readily available to eager students.

Kurako subscribed to all available foreign journals and kept an interpreter to which he gave the most interesting literature on metallurgy for translation. The article were then typed and Kurako would hand such translation to his students and say,

"Read this; it is an interesting paper."

Kurako organized the work of the plant in such a way that the shift engineer was really in charge of the furnaces. The post of the shift engineer itself was created by Kurako; it was not known anywhere previously. He did not interfere with the instructions of the shift engineer. In the case of an operational breakdown of the furnace Kurako would never stay to supervise. He would come for a few minutes, look around and go, saying:

"Here you are, you can work it out by yourself."

Kurako used to explain in his own way and sometimes quite differently from the textbooks, but as experienced showed, correctly, many involved and difficult problems. Scourges of the blast furnace art were the so called "break-through" and "burning-through" of the hearth. Many suggestions were made for the strengthening of hearth construction but the break-through was still a frequent occurrence, and no textbook gave a simple convincing explanation of the technical cause of this trouble. Kurako grasped the problem and provided an explanation. This was the first detailed and logical explanation of the process in the furnace. Having understood the problem he then modified the hearth accordingly. This type of hearth is now built in the largest furnaces.

Kurako designed several noteworthy blast furnace plants but the designs remained on the drawing board. In his design office Kurako, together with his students, was equipping the largest furnaces in the world, constructing railroad tracks, installing tapholes and hoppers, calculating every girder and bolt, but he never erected a plant of his own design.

On the eve of the Revolution, on the invitation of the joint-stock company "Kopikuz," Kurako went to Kuzbass to design a metallurgical plant in Siberia. But having met several difficulties, inevitable to a large scale project in a new region, the "Kopikuz" Company did not start construction before the October Revolution.

After the Civil War Kurako drew the attention of the Soviet Government to the necessity of building a metallurgical plant close to Siberia's coal resources. The Soviet Government gave him their support. He began work with enthusiasm, but the difficult circumstances of the post-war years delayed the first stages of the project; in February, 1920, Kurako was taken ill with typhus and died without realizing his dreams.

Two weeks before his death he joined the Communist Party.

The memory of Kurako is alive among blast-furnace people. This national hero has his place in the hearts of the metallurgists as a master of blast furnaces, as a "first striker" and also as a remarkable technician passionately absorbed in his work.

METALLURGY ABROAD

A VISIT TO SWEDISH METALLURGISTS

Yu. N. Kozhevnikov

Steel production. Because of the lack of local fuel resources, Sweden's production of open-hearth steel has remained unchanged for the past 17 years, but the production of electro-steel and converter steel has increased, as has the manufacture of steel by the Duplex process (converter-electric furnace).

In 1955, out of the total steel output, 20% was manufactured by basic and 11% by acid open-hearth process. Steel made in basic furnaces is used mainly for nongraded rolled products. Most of the basic open-hearth furnaces are of 20 to 60 ton capacity and only the Fagerst plant has one 80-ton open-hearth furnace. The walls and the roofs of these furnaces are lined with basic material and the checker is of refractory brick; the life of the lining amounts to 600-650 heats. Towards the end of a campaign the length of time of heats is usually by 10-15% greater than at the beginning. A furnace is periodically operated on the Duplex process with a Bessemer converter. A batch of steel to be made in an 80 ton furnace when using cold charge takes 8 hours; when hot metal is used it lasts six hours, and in Duplex process it takes 4 hours.

For the measurements of temperature in all steelmaking furnaces, immersion thermocouples are employed.

In acid open-hearth furnaces carbon and alloy steels of various grades are made: steel for saws, files, magnets, and cables, as well as various ball-bearing steels. Produced steel for files contains 0.7-0.8% C and 2% Ni and steel for magnets contains 6% W. The general opinion in the steelmaking industry is that in acid furnaces a better quality ball-bearing steel is obtained.

Acid steel in Hagfors and in Sandwicken is made using oxygen. In the Hagfors plant oxygen is blown through the metal for about 15 minutes after it has been melted, and after a half hour interval oxygen is blown again through the bath for 3 minutes, up to 50 cu. m of oxygen being consumed; in all the consumption of oxygen per batch in a 20 ton furnace is 200 cu. m.

The silico-reducing process is employed in the manufacture of ball-bearing steel; ferro-silicon is not added and the metal is finally reduced with aluminum. The charge consists of 50-60% hot blast-furnace metal and up to 20% sponge iron; the remainder is scrap free of sulfur and phosphorus. In the Sandwicken plant, approximately half the amount of aluminum (36 g per 1 ton of steel) is added before the tapping; the remainder is added into the ladle in the course of teeming. The use of small quantities of aluminum for the final reduction of metal improves the plasticity of ball-bearing steel. As a rule, steel is cast from above. In some plants (Sandwicken) steel is cast from a ladle through two nozzles into two ingots simultaneously; the weight of the ingots is 500-700 kg.

Arc furnace and induction furnace steelmaking is widely practiced in Sweden; in steel plants, arc furnaces of various makes (ACEA, Demag and others) with capacities of 10 to 45 tons are found.

The largest arc furnace (ACEA) of 45 tons capacity with 13,000 kw transformers and with ten alternative secondary voltages is in operation in the Nikrop plant and belongs to the Uddegolm firm. The bottom of the furnace housing is constructed of nonmagnetic steel with the object of installing in future the equipment for electromagnetic mixing of the bath.

The furnace uses cold charge and produces conventional steels. The duration of a heat is 4-5 hours and the charging lasts 7-8 minutes. The electricity consumption varies between 610 and 650 kw-hours/ton; 4.5-5 kg of graphite electrodes is consumed per 1 ton of steel.

As a rule, the arc furnaces in Sweden are charged from above by means of buckets, with the exception of the Domnarvet plant where the charging crane is employed. In the Domnarvet and Norboten plants the charge for the arc furnaces, in the Duplex process (Thomas converter-electric furnace), consists of 20% pig iron, 15-25% scrap and 55-60% Thomas metal.

In the Fagerst plant the arrangement is: the blast furnace; 20 ton Bessemer converter; 30 ton arc furnace with an electromagnetic mixing of the bath. The Bessemer converter receives hot metal containing 1% silicon and 0.8% manganese. Air blast pressure is approximately 2.5 atm, duration of blowing is 15 minutes. During blowing the converter is kept for 7 minutes in vertical position and 8 minutes in the horizontal. In the horizontal position, surface blowing of the bath is employed with the object of lowering the saturation of the metal with nitrogen. According to the data given by the plant, the metal thus treated contains 0.008-0.050% N, i.e., half as much as the conventional Bessemer metal.

The Domnarvet plant works according to the following scheme: blast furnace; 28 ton Thomas converter; 28 ton arc furnace. The converter receives metal of the following approximate content: 3.5% C, 1.8% P, 0.30% Si and 0.50% Mn. Up to 15% of scrap is used in the steelmaking.

The blowing-through lasts 12 minutes, air enriched with oxygen up to 30-35% being employed. Steam-air mixture is also supplied for the blowing. The metal is blown-through from below; the life of converter bottom is about 70 runs. Up to 30 cu. m of oxygen and 160 kg of lime is used per 1 ton of metal. After the blowing, a liquid metal of approximately following composition is obtained: 0.2% C; 0.03-0.07% P, 0.02-0.03% S, and not more than 0.001% N.

Out of the total amount of metal produced by the Duplex process 70% is intended for sheet rolling (0.14% C; 0.05% Si; 0.06% Mn; not more than 0.002% P and not more than 0.003% S) and 20% is intended for rails.

Thus in Domnarvet plant, steel for sheets and rails is obtained by Duplex process, notwithstanding the fact that the application of oxygen and air-steam mixture in the Thomas converter ensures a high quality steel with a low nitrogen content.

The reason is that the marketing of converter steel for the above purpose, even when produced with the use of oxygen, is not permitted by the Swedish technical regulations. The manufacturers at the plant maintain that the converter-made steel with the application of oxygen is not inferior to open-hearth steel but the corresponding tests have not yet been carried out to the extent required.

The Norboten plant works according to the scheme: blast furnace; basic converter; electric furnace. The molten iron supplied to the converter contains 2.5% P and not more than 0.07% S. Initially 150 kg of lime per ton of metal and then molten metal is charged into the converter; after the blowing is started, 2-3% scrap is added; the metal is blown with air at 2.5 atm for about 18 minutes. After the blowing, the metal obtained contains not more than 0.07% P and not more than 0.03% S.

The electric furnace charge consists of 20% phosphorus and sulfur-free blast furnace metal and 15% scrap, the remainder being a Thomas-converter, liquid, intermediate product. Duration of run is 2.5-3.5 hours when a molten charge is employed, and 5-5.5 hours when a cold charge is used. Average electricity consumption is 480 kw-hours per ton of steel. In the electric furnaces, conventional steel with 0.1 to 0.7%C is produced. Silico-manganese steel with 1.5-2.0% Si and 0.8 to 1.0% Mn is also produced in small quantities. The metal is teemed from above into 3-5 ton ingots.

At the Fagerst plant, Hagfors and Sandwicken, alongside the arc furnaces and basic and acid open-hearth furnaces, the high frequency induction furnaces are installed, which produce 18-18 stainless steel with a low carbon content, and other alloy steels.

The Hagfors plant manufactures stainless steel by Duplex process: converter – 6 ton induction furnace with an acid crucible. The charge consists of 60% molten metal with 0.02%C, the remainder is scrap which is free from harmful impurities and alloying additions. First the scrap and alloying additions are charged and heated, then the molten metal is poured in. The duration of the heat of the induction furnace is 2-2.5 hours, and the content of carbon in the final product does not exceed 0.06%.

The Fagerst plant has three 10-ton induction acid crucibles, two of which are in operation, while one is kept in reserve. The crucibles are supplied by two generators of 2200 and 700 kw.

For the period of melting, the 2200 kw generator is switched on; after the charge is melted it is replaced by the 700 kw one, the more powerful one being then switched over to the other furnace. Thus the two generators are used alternately on the furnaces: the more powerful one for the melting of the charge and the other for the metal refining period. The duration of heat in induction furnaces is 4 hours, including 2 hours for the melting of metal.

The furnaces of Sandwicken plant are of 4.5 ton (1200 kw generator) and 0.5 ton capacity. A cold charge is employed. It consists of steel scrap, sponge iron and alloying additions. The duration of heat is 2 hours. The three grades of steel from the induction furnaces contain 0.04%, 0.06% and 0.08% carbon, respectively.

Special pressed thermite packs, inserted in the mold and forming a feeder head, are employed for the heating of the top end of ingots at Nibi Brooks plants and at some other plants. The application of pressed packs made it possible to raise the yield of satisfactory steel to 92%.

Electromagnetic mixing of the bath. At the suggestion of the firm ACEA, the electromagnetic mixing of metal during steelmaking in the furnace has been applied in Sweden for several years now. The firm has built special equipment for metal mixing in several plants in Sweden and other countries.

The data of the equipment employed for the furnaces of up to 30 ton capacity are as follows: frequency 1-1.5 per sec, current 600 amp, voltage 200-240 v; for the furnaces of up to 100 ton capacity: frequency 0.5, voltage 270 v, current 750 amp; for furnaces above 100 tons: frequency 0.3-0.4 per sec, voltage 320 v, current 1000-1200 amp.

An electromagnetic stirrer with a frequency of 0.38 per sec and 1200 amp, 765 kw has been incorporated in a 150 ton arc furnace (Belgium).

The principle of the electromagnetic stirrer is analogous to the principle of the synchronous motor. An arc stator for stirring the bath is situated under the furnace, attached to the lower part of the housing. When an electric current is passed, the magnetic field induces currents in the steel bath, inducing motion of the melt (by down- and up-flowing currents). For effective mixing of the metal, the magnetic field should be as near as possible to the molten bath. Hence the lower part of the housing is usually made of nonmagnetic material, preferably of 18-8 chrome-nickel steel and a low frequency is employed in order to avoid large losses in eddy currents.

The winding of the stirrer has similar action to the stator of an asynchronous motor and the bath itself corresponds to the rotor. The direction of mixing can be changed during the run by means of a simple switch.

The induction equipment for mixing is supplied by a power system ensuring low frequency current supply.

The electricity consumption for stirring is small: for instance, the stirring of 30-ton arc furnace bath requires 180 kwh at $\cos \varphi = 0.5$. A typical installation for the stirring of a 30 ton arc furnace bath weighs approximately 10 tons.

The operation of such stirring equipment is button-controlled and very simple in use.

The advantages of the induction stirring in the arc furnaces are: 1) the duration of the run is shortened (approximately by 20%), the furnace output increases; 2) a depth increase of the bath is made possible and hence the increase in furnace capacity and weight of a batch; 3) the quality of metal is improved, the uniformity of its chemical composition is attained more rapidly, which is especially important in the manufacture of alloy steel; 4) the burning-out of sulfur and phosphorus is accelerated, the removal of slag and temperature control of the bath are made easier.

Swedish metallurgical plants maintain that the capital cost of a stirrer is recovered within 1-1.5 years.

The equipment for the continuous casting of steel. The Nibi Brooks plant, producing steel plate and stainless steel tubing, introduced, in 1954, the equipment for continuous steel casting on the model of the American system or of Rossi-Youngance.

Rectangular ingots of carbon and stainless steel of 90 x 90 mm, and circular ingots of 180 mm diameter as well as slabs of 330 x 55 mm section, are cast here.

The quality of the surface of ingots and slabs is quite satisfactory, but the surface quality of the stainless steel ingots is somewhat inferior, hence the material intended for tube manufacture has to undergo a preliminary machining.

Examination of a number of rectangular and circular ingots cast by the continuous casting machine showed that they had an excellent structure. A slight porosity was detected in the slab along its axis.

The equipment for continuous steel casting is of a comparatively light construction; it is situated at the end of the steel casting shop, partly above and partly below ground level. The casting is done from a platform about 18 m above ground level.

A casting control desk is mounted on this platform, as well as a stand for a ladle of a teapot type, with an electromechanical driving gear for tilting the ladle. Steel is poured, without the use of a stopper, via an intermediate attachment by means of which the course of casting is controlled by varying the level of metal in the intermediate attachment.

The crystallizer is of copper, one-piece casting with internal housing which serves for the water-cooling of the crystallizer. Tubes, for the required water circulation, are fitted inside the housing. The upper part of the crystallizer is covered with a copper plate 20 to 25 mm thick having a circular groove corresponding to a similar groove in the upper face of the crystallizer for the lubrication feed. The lubricant is fed into the groove through small tubes arranged on the outer perimeter at a distance of 100-120 mm from each other. The lubricant is fed to the internal surface of the crystallizer through a slit 0.1 mm wide over the whole perimeter of the crystallizer.

The height of the crystallizer for the rectangular and circular ingots casting is 900 mm, and for slab casting 750 mm. The outer dimensions of the crystallizer for the slabs are 250 × 500 mm. When the machine is started the crystallizer is primed.

The crystallizer is mounted on a guiding mechanism of reciprocal movement. The lowering of the crystallizer is effected by means of the driving rollers, and raising by means of springs. The movement of the crystallizer is 12-35 mm (usually 20 mm). The velocity of rise of the crystallizer is 3 times higher than the speed of casting. The level of the metal in the crystallizer is kept at 40-50 mm below its rim. The crystallizer is lubricated with vegetable oil. During the lubrication a protective gas is employed (propane or butane).

The speed of steel casting for the various section ingots and slabs is: for the rectangular ingots 90 × 90 mm – 30/minute or 180 kg/min; for circular ingots 180 mm diameter – 1.2 m/min or 240 kg/min; for the slabs 330 × 55 mm – 1.7 m/min. or 230 kg/min. It is maintained at the plant that the speed for slabs should be increased. Steel from the ladle of 15 ton capacity is cast in 1 hour 20 minutes.

Secondary cooling of the ingots is done by sprayed water. Total water consumption for the continuous rectangular ingots constitutes 400 liters/min, for the circular – 700 l/min, and for the slabs 900 l/min.

The ingot from the crystallizer is pulled through one driving roller stand under which the gas cutting equipment is suspended on sprocket chains. The cutter of the gas cutter machine has two jets. After cutting, the ingots fall into the receiving box where they are manipulated onto the roller train and are further lifted by a hoist to the floor level of the plant.

The machine-cast slabs are used for sheet rolling and cold-strip rolling, and circular ingots for the manufacture of tubes by the extrusion method.

STEEL INDUSTRY IN ENGLAND

N. G. Veselkov

Chief Engineer of Stalproekt

The steel output in England in 1955 was 20 million tons, of which 87.3% was open-hearth steel, 5.5% electric-made steel and 6.4% converter steel.

By far the largest share of the steel output (6.4 million tons per year, or 32%) was produced in the Southwest and West of England, where the plants of the large firms are situated: the Steel Company of Wales (three open-hearth furnaces in Abbey plant, with an annual output of 2 million tons), Richard Thomas and Baldwin (Ebbw Vale plant, with 0.7 million tons per year) and John Summers and Sons (Shotton plant, with 1.1 million tons per year). These plants specialize in the production of thin plate and sheet steel.

The output of steel in the Northwest of England amounted to 4.0 million tons; the most modern plant in this region is that of Dorman Long in Lakenby, producing mainly structural steel sections.

The next important region of steel manufacture is the Sheffield area where the high quality steel plants of Samuel Fox, Firth and Brown and others, are situated, producing 2.6 million tons per year.

Steel output in Scotland reaches 2.3 million tons per year. The largest plant here is the Colvilles Clydebridge plant, specializing in steel plate for ship building.

Converter Thomas steel is mainly manufactured in the Corby plant owned by the firm Stewarts and Lloyds in central England.

The open-hearth steelmaking in England up to recent years was based on the small plants of continental type of small capacity where all processes were integrated in one building (including the steel channelling, preparation of molds, stripping of ingots and charge yard).

The presence of coal and phosphorus-containing iron ores and the absence of oil in England have affected the steelmaking processes; the active mixers, the Talbot and the Thomas processes are fairly widely employed; the open-hearth furnaces are preferably heated by generator gas.

After the war, however, many metallurgical plants in England underwent considerable modernization and extension. This applies primarily to the plants situated in the Southwestern and Western regions, which rely mainly on the imported ore; these plants have pig-iron of a normal composition suitable for the open-hearth process. Here, new highly efficient open-hearth plants have been built, with different operational processes housed in separate buildings; a separate charge yard, steel casting into the models on bogies, mold yard and stripping building, i.e., plants with main buildings and auxiliary sections of an up-to-date design, similar to the plants in the USSR and USA.

The Abbey open-hearth furnaces of the Steel Company of Wales and Shotton furnaces of John Summers and Sons are extremely interesting. Both plants use molten metal feed charge of normal composition and after the completion of the projected modernization and extension, the plants will have twelve open-hearth furnaces each, with a total expected annual output of 1.7 to 2.0 million tons, and furnaces being of 230-240 tons capacity each.

The modernization of other plants was carried out taking into consideration the processing of local phosphorus-containing iron, and therefore the open-hearth plants are noted for their individual planning and design.

The steelmaking plants of the high-quality steel manufactures have undergone lesser modernization, apart from Samuel Fox in Sheffield where a new 80-ton arc furnace is in operation.

The Types of Processes

The scrap-ore process. The new Abbey open-hearth plants (8 furnaces of 200-ton capacity and 2 furnaces of 230-ton capacity) are operated on the scrap-ore process, the charge consisting of 60-65% molten metal which contains 0.5-0.6% phosphorus; the plants produce effervescent mild steel for sheet and plate.

The technology of the process is approximately analogous to the practice of our factories.

The scrap-ore process with an active mixer. In steelmaking with pig iron obtained from the local ore and containing a comparatively large amount of phosphorus, the active mixer or Thomas-Gilchrist process is employed.

In the new open-hearth plants of Dorman Long (five tilting open-hearth furnaces of 360 ton capacity each) and of Clydebridge Colvilles (five fixed open-hearth furnaces of 85 ton capacity each and three tilting open-hearth furnaces of 300 ton capacity each) there are active mixers of 600 ton capacity in which the silicon content of metal is reduced from 0.9-1.2% to 0.2-0.5%. The phosphorus content changes very little: by 0.1-0.3%; the content of other elements remains practically unchanged. The amount of molten iron, depending on the availability of scrap, constitutes 80-40% of the furnace charge. The plants make steel for structural sections and plate steel for shipbuilding.

The active mixers are situated between, and in one line with, 300-360 ton tilting open-hearth furnaces. The molten metal is delivered to the mixers on the side of the casting bay. In the plant of Dorman Long the metal from the active mixer goes through the casting bay and is charged into the open-hearth furnace from the back-wall side. With such a method of charging the cranes become overworked and therefore in this plant special semi-gantry cranes have to be used, on which 120 ton ladles with two tappings are placed. Such cranes have complicated considerably the work in the casting bay of the plant.

The discharge from the active mixer on the side of the furnace charging bay (Clydebridge Colvilles Plant) complicates the operation of charging machines.

The above disadvantages indicate a not well-planned introduction of active mixers, expecially in the plants with large capacity open-hearth furnaces. It should be pointed out that the lowering of the silicon content in metal can be achieved by the preliminary blowing of oxygen through the smelted metal in the ladle. The corresponding experiments carried out in some plants have given positive results; in these experiments, apart from oxygen, also steam was successfully applied for the elimination of froth and for the lowering of metal waste.

The preliminary blowing of metal in ladles does not require complex and expensive equipment; the operation of the open-hearth furnace is facilitated and its productivity increased. In this connection it was decided in some English steel factories, after the construction of oxygen plants, to introduce the use of oxygen in the ladles.

The treatment of molten iron with oxygen is advantageous not only in the case of phosphorus-containing metal but also in the case of the usual open-hearth metal, as the lowering of the silicon content enhances the decrease in the amount of slag in the furnace, which results in turn in the increased productivity of the furnace, and this fact has been confirmed by a number of plants abroad.

In this connection the relevant experiments at "Azovstal," NTMZ and "Zaporozhstal" plants are very advantageous.

The tilting open-hearth furnaces in the above-mentioned steel works in England are, as a rule, working with a full delivery of the batch (complete draining of the furnace) into 3-4 ladles consecutively. The Talbot process is not in use. The phosphate slag contains 16.0% P_2O_5, solubility of the slag is 80-90%.

Thomas process. The steel for tubing in the Corby plant of Stewards and Lloyds is manufactured by the Thomas process (five converters 25 tons each), and so is mild rimming (effervescent) steel for sheeting as well as dynamo steel with 0.5-2.5% silicon at Ebbw Vale plant of Richard Thomas Baldwin (three converters 25 tons each).

At the Corby plant, a preliminary desulfurization of metal with soda, because of an increased sulfur content in the pig iron (up to 0.2%) is applied in two stages (before and after the mixer). The metal poured into the converter contains 0.05% S, 2.0% P, 0.9% Si, and 0.6% Mn. 12.5% of lime is charged into the converter and at the end of blowing another 4% of limestone is added. The blast is not enriched with oxygen. The total duration of blowing is 15 minutes, and the time from discharge to discharge 20-25 minutes. Heated ferromanganese is added to the converter.

The phosphate slag contains 18% P_2O_5, the solubility of slag is 99%. The life of converter lining is 250 runs, the life of bottom 75 runs.

The Thomas converters at Ebbw Vale plant were primarily intended for working in the Duplex process together with open-hearth furnaces. As this process, however, proved uneconomical the converters are operating independently. The technology of the process and the operating efficiency of the plant are roughly the same as at the Corby plant, with the exception that the ferromanganese is introduced into the converter in a liquid state, and the life of the converter's bottom amounts to 55 runs. This plant intends, after the construction of an oxygen station, to introduce the bottom blowing with oxygen and steam.

The Abbey Steel Company of Wales with the participation of the firm Demag has designed and has begun the erection of a converter plant, with three 50 ton converters designed for the bottomblowing with oxygen and steam and using phosphorus containing metal for mild rimming steel. The metal contains 1.6 %-1.8% phosphorus and 0.25-0.35% silicon.

Metal with a higher silicon content is not used. A preliminary blowing with oxygen of such metal in the ladle with the object of lowering the silicon content to a permissible amount, is planned.

The bottom blowing of the molten metal in the converter with oxygen and steam, in contradistinction to the L-D process (oxygen blowing from above), is more flexible, it ensures more efficient and steady production and makes possible the use of metal with high phosphorus content; in this process colorless fumes are given off by the charge in the converter. This method of blowing is very promising. A considerable disadvantage is the small capacity of the existing converters compared with the modern open-hearth furnaces of 250-500 ton capacities and hence the converters constructed have a limited output production.

Electric steelmaking. Alloy steel is manufactured at the following steel works: Samuel Fox (a new electric steelmaking plant with an 80-ton furnace, Firth and Brown (old plant with three 35-ton arc furnaces and two 6-ton induction furnaces) and Panteg plant of Richard Thomas and Baldwin, and several others. Of great interest is the new plant with an 80-ton arc furnace (erected by the firm Birleck) at the Sheffield works of Samuel Fox.

In the 80-ton furnace the electromagnetic stirring of the bath is applied which ensures a uniform heating of metal and facilitates the removal of the slag. The electromagnetic stirring does not shorten the life of the bottom.

In the making of stainless and alloy steel the average time of a run is 7 hours and the life of the bottom is 140 runs. For the charging of free-flowing and alloying materials a ground-type loading machine is used. Steel is cast by the siphon method (bottom casting) into 2.5 ton ingots. Two-nozzle, steel ladles are used. This makes it possible to shorten the time of casting and avoid large temperature variation.

The Fuel

In spite of the absence of local oil fields in England, the metallurgical heating of open-hearth furnaces with fuel oil or fuel oil and cold coke-oven gas is generally practiced in the metallurgical plants. In particular, this type of heating is used in all new open-hearth plants.

Some old open-hearth plants, previously fired with hot generator gas, are now being converted to fuel oil.

The mixed (coke oven-blast furnace) gas with reheating in regenerators is rarely used in England.

Because of the low calorific value of the coke-oven gas, when it is used for open-hearth furnace heating, its pressure must be raised and a considerable quantity of oil fuel added. In such heating methods in English open-hearth furnace plants the oil consumption represents 40-70% on the basis of heat supplied, the coke-oven gas

pressure being 1800-750 mm of water. The fuel oil is atomized with steam under 11 atm pressure. Attempts to decrease fuel oil consumption by increasing the amount of coke-oven gas under a higher pressure were unsuccessful owing to the exceedingly short flame in the furnace.

The heat loads of open-hearth furnaces with silica brick roofs of English plants are approximately by 10-15% lower compared with similar plants at home. The fuel consumption, in spite of a low productivity capacity of open-hearth furnaces, is very low: 0.9-1.1 million kcal/ton, or 130-160 kg of conventional fuel per 1 ton of steel; this is attained owing to small heat losses in the furnaces (the absence of good heat conductors (magnesitochromite roofs) absence of water cooling of roof-base girders and of gas window caissons, absence of gas losses during the valve reversing etc).

Open-Hearth Furnaces and Plants

The main dimensions of structures and furnaces. The table gives the main dimensions of structures and furnaces in the new open-hearth plants in England, built between 1951-1953.

For purposes of comparison, the dimensions met in the practice of Soviet plants are given in brackets. The main difference is in the bath dimensions of fixed hearth furnaces. The relatively large floor surface of English open-hearth furnaces comes from the desire to have a shallow bath and a thinner layer of slag; apart from that the length of the bath should be increased because of the elongated tongue of the flame.

The absence, in this case, of checkers and slag chambers permits a longer furnace with the same dimensions of the plant structure.

The layout of open-hearth plants. A particular feature of open-hearth plant design is the storage and delivery of the limestone, lime and dolomite.

In the Lakenby plant of Dorman Long and Co. this material is delivered by cars to a separate building where it is discharged by means of a car tipper into separate compartments and then carried by a conveyor or self-loader to the plant. There is no charge yard for the scrap and ore, and these materials are delivered to the plant in open cars into the charge space where they are reloaded by means of magnetic cranes into the charging boxes. There are no grab cranes. The disadvantage of such a method is a comparatively complicated system of delivery of the free-flowing materials, the system being suitable only for plants of fairly small capacity. In the building with friable, free-flowing materials a good deal of dust is produced and special exhausting equipment for its removal is required.

The works of John Summers and Sons also have a separate building with a car dumper for the unloading of dolomite and lime. From the delivery compartments, materials are charged into charge boxes on bogies and are delivered by a scaffold bridge to the plant. In the charge yard, scrap ore and limestone are stored and are delivered to the plant by conventional methods.

In the Abbey Steel Company, scrap is stored in the first bay of the charge yard next to the charge wing, and the friable materials are stopped in the second bay next to the first. On the bridge-girder of a grab crane there are feed bins through which ore and limestone are accurately discharged into charge boxes.

The open-hearth furnace construction. In the absence of magnesitochromite refractories the open-hearth furnaces of English plants have Dinas brick (silica brick) roofs, and only in some cases "zebra" roofs are constructed on small sections along the front and back walls. The end face of the furnaces (vertical channels and roof above them) are lined with chrome-magnesite bricks.

The following particular features of the open-hearth furnace design should be mentioned:

1) The introduction of single-channel ports instead of two-channel ports in oil-fired furnaces. In the plants, however, where the both types are installed for comparison, no difference in the efficiency and durability of the furnace has been observed.

2) The new 230-240 ton open-hearth furnaces are designed with single chamber regenerators (the furnaces are oil-fired) with flat suspension roofs in the generator chamber and slag chambers, and with flat suspension walls of vertical channels.

In view of the presence of single regenerators only, such roof design is advantageous.

Item	Firm		
	Abbey Steel Company of Wales	Shotton; John Summers and Sons	Lakenby; Dorman Long and Co.
Type of furnace	Fixed hearth	Fixed hearth	Tilting hearth
Weight of charge	200-230	175-200-240	360
Width of (in metres):			
casting bay	22.86 (22.0)	23.77	22.86
furnace bay	24.38(27.5)	23.77	19.81
charging bay	17.73(18)	19.66	19.81
Column spacing along the furnaces, m	33.43 (36)	33.43	38.10 (37.5)
Height of operating platform, m	6.7 (7.0)	5.79	–
Charging machine	Ground type, load-lifting capacity 8 tons	Ground type, load-lifting capacity 8 tons	Type charger
Hearth dimensions for the weight of charge, tons	230 (250)	240	360 (350)
length, m	19.2 (14.5)	19.2	15.24 (15.6)
width, m	4.95 (5.3)	4.83	5.49 (5.2)
area, sq. m	95.0 (77.0)	94.0	83.5 (81.2)
depth of bath, m	0.85 (0.95)	–	1.22 (0.95)
Volume of checkers, cu m	308 (341)	283	325

3) The ports of tilting open-hearth furnaces, together with the vertical channels, can be removed or shifted within the limits of the water seals of the vertical channels. Owing to the shifting of ports (by means of hydraulic cylinders) a very small slit between the port rings and the tilting part of the furnace can be ensured.

4) The top of the ports is most frequently lined with high alumina bricks (42% Al_2O_3).

These checkers are blown-through once a week during the cold maintenance of the top (change of roof and ports).

5) In the Ebbw Vale works where the open-hearth furnaces in the old plant have not yet been converted from hot generator gas to fuel oil, during the gas mains maintenance the furnace is fired with the jet burners installed at the back wall. The oil flame enters the furnace at a right angle to the axis of the burner (Fig. 1). Such an arrangement makes it possible to eliminate the hot idle periods and has justified itself to such an extent that even in the case of an oil-firing system the burners are mounted not from the end face of the furnace but at the back wall.

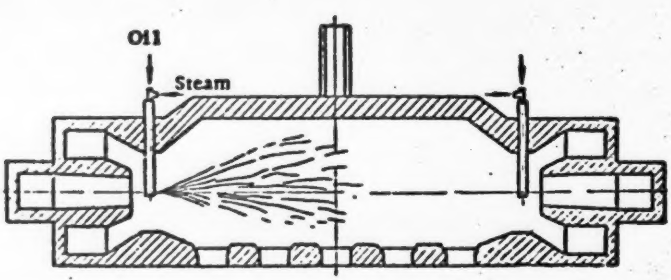


Fig. 1. Combined heating of 120-ton open-hearth furnace.

6) The slag bogie equipped with an electric motor and with a ladle under the furnace moves on the scaffold bridge. The current is supplied through a current collector, from the mains which pass underneath the

furnace and are guarded from above by sheet-iron guards.

The Steel Casting

Casting of effervescent (rimming) steel. The peculiar features of the casting of mild rimming steel are:

1. Steel is cast from above into "bottle-type" (narrow-end-up) molds. The output of useful ingots from this type of mold is 90-95% and is by 5-7% higher than from the conventional tube molds. The narrow-end-up molds have a simple form with rifled walls in the corners, but their cleaning and lubrication with sprayed pulverized pitch is done in a horizontal position. Even when taking into account the intricate preparation of the molds, the increase in useful output by 5-7% makes the application of these molds for rimmed steel casting a very advantageous proposition.

2. Aluminum is added more frequently into the ladle, up to an amount of 0.4 kg/t; it is sometimes added in the molds, in the amount up to 0.025 kg/t. After casting, the ingots are covered with a cover or a plate sprayed from above with water.

3. The bottom plates have refractory inserts on which sheet cuttings are placed, on which, in turn, "cuffs" 0.5 m high and folded from 1.5-2 mm plate are mounted.

The ingot surface is quite satisfactory and in view of high output of useful ingots this method of casting of mild rimmed steel is fully justified.

The continuous steel casting. There is equipment for continuous casting in two steel works and in the scientific research institute (BISRA) in Sheffield. All the installations are above ground level, and rectangular ingots of comparatively small section, 50-100-125 mm, are cast from the ladles of 0.5, 2 or 5 ton capacity. Steel: carbon steel, high speed, and alloy steel. The construction of machinery and of the crystallizer is very simple; the equipment operates periodically.

The Use of Oxygen

Oxygen is not used for the intensification of fuel combustion in the open-hearth furnaces owing to the danger of "running" of the silica roofs. The steel works of the Abbey Steel Company of Wales are using oxygen in 210-ton open-hearth furnaces with silica roofs for the making of plate steel for sheeting and high drawing.

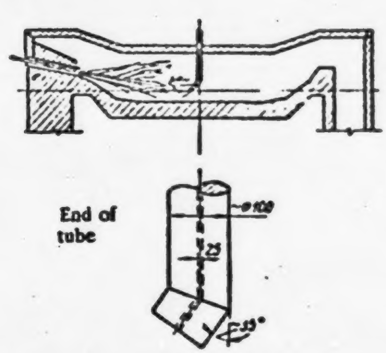


Fig. 2. Oxygen blowing into the bath of open-hearth furnace.

Oxygen is introduced by means of water-cooled tube, bent at an angle of 35° from vertical and is frequently turned towards the incoming flame (Fig. 2) and thus the oxygen stream is somewhat diverted and the slag spattering does not affect the tubing. A tube lasts for 65-80 blowings (runs). The introduction of oxygen begins when the bath contains 0.3-0.4% C and ends at 0.04-0.05% C. Oxygen consumption is 4.5 cu m/t. Oxygen pressure is 13.5 atm. On changing over to steel-making with oxygen the furnace output increased by 10%; the durability of roofs remained unchanged.

Operating Efficiency of Open-Hearth Furnaces

In the new English open-hearth plant the total (hot and cold) idle periods amount on the average to 12-13%. The data on open-hearth furnace steelmaking are given below.

At the 210 ton Abbey open-hearth furnaces with silica roofs employing oxygen treatment of the bath the length of time for a run is on the average 11 hours; 143,000 tons of steel is produced annually.

At 200-ton furnaces in Shotton plant (with silica roofs) working without oxygen the average time for a run is 11.5 hours; 127,000 tons of steel is produced annually.

At the tilting hearth furnaces (capacity 360 tons) of Lakenby plant working with phosphorus-containing metal and employing an active mixer the mean time of the run is 18 hours; annual output is 150,000 tons.

The life of furnace roofs in English plants is also expressed in weeks and constitutes 150-180 runs. The life of the checkers is considerably longer. If purging of the checkers during the cold maintenance of the furnace is used, the life of the checkers reaches 1 to 2 years.